Wilson, D.W.
1936

What Measures do People know and why?

BOSTON UNIVERSITY
SCHOOL OF EDUCATION
LIBRARY
Ed.

The Gift of Dorothy W. Wilson

Thesis
Wilson, D.W.
1936

Ed.
Thesis
Wilson. D.W.
1936
Stored

Boston University
School of Education

Thesis

WHAT MEASURES DO PEOPLE KNOW, AND WHY

Submitted

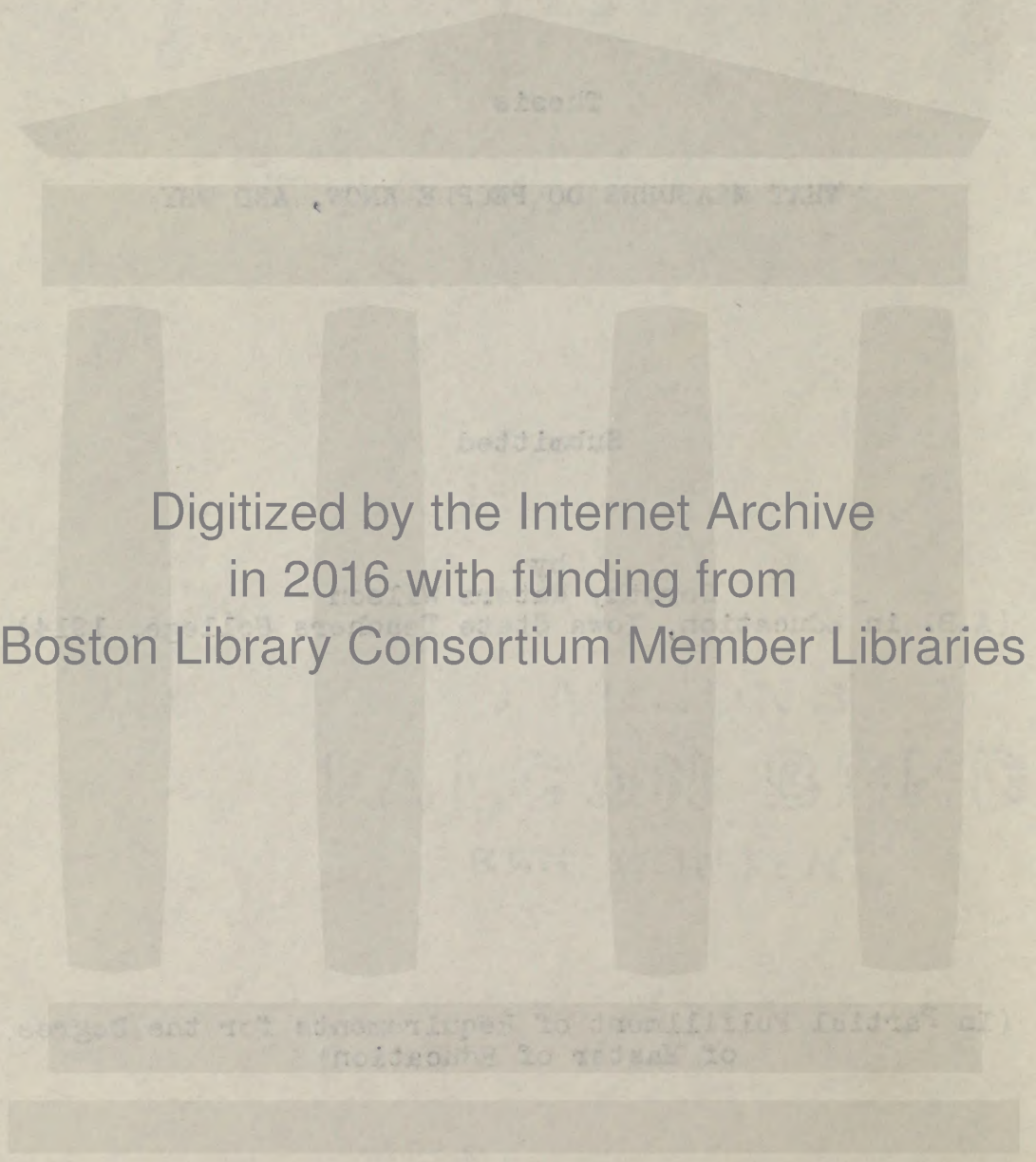
by
Dorothy Waters Wilson
(A.B. in Education, Iowa State Teachers College, 1914)

(In Partial Fulfillment of Requirements for the Degree
of Master of Education)

1936

First reader: Guy M. Wilson, Professor of Education
Second reader: Franklin C. Roberts, Associate Professor of Education
Third reader: Mabel C. Bragg, Associate Professor of Education

Boston University
School of Education
Library



Digitized by the Internet Archive
in 2016 with funding from
Boston Library Consortium Member Libraries

https://archive.org/details/whatmeasuresdope00wils

D. W. Wilson.
of Education

Contents

Page

I. The problem. 1

1. What measures do people know and why?
2. Bearing on the curriculum in arithmetic

II. Other Studies in the Field. 3

1. Wilson, 1909
2. Coffman and Jessup, 1914
3. Monroe, 1917
4. Wilson, 1918
5. Wise, 1919
6. Williams, 1921
7. Woody, 1922
8. Calloway, 1923
9. Traniello, 1930
10. Louth, 1931
11. Sala, 1934

III. Method of Study. 13

1. How questions were chosen
2. Make-up of questionnaire
3. To whom questionnaire was given

IV. The Data and Its Interpretation. 23

1. Statistical treatment
2. Item summaries
   - Section 1
   - Section 2
   - Section 3
3. Further typical, illustrative and special items
4. Resulting tables and comparisons

V. Significance of the Percentage Differences. 82

VI. Summary and Conclusions. 87

VII. Further Studies Suggested. 91

VIII. Bibliography. 93

Appendix A. List of answers classified as right, wrong, the most common measure, and a fair estimate. 95

Contents

Exhibits, Figures and Tables

		Page
Exhibit 1.	First form of questionnaire	14
Exhibit 2.	Second form of questionnaire	21
Exhibit 3.	Summary sheet on 1-b, Gasoline; and 1-g, Meat	24
Exhibit 4.	Summary sheet on 1-u, Oats	25
Exhibit 5.	Summary sheet on 2-a, Height of a dining-room table . .	26
Exhibit 6.	Summary sheet on 3-k, The number of cubic inches in a cubic foot . . .	27
Figure 1.	Graphic representation of selected items of Table 1A . . .	33a
Figure 2.	Graphic representation of the items of Table 2A .	40a
Table 1A.	Summary of correct answers in Section 1.	44
Table 1B.	Summary of part right, part wrong answers in Section 1 .	46
Table 1C.	Summary of wrong answers in Section 1	47
Table 1D.	Summary of illegible answers in Section 1	49
Table 1E.	Summary of no answers in Section 1	50
Table 1F.	Summary of answers not a unit of measure in Section 1 .	55
Table 1G.	Summary of answers which are the most common measure, Section 1 .	56
Table 2A.	Summary of answers in Section 2 considered a fair estimate . . .	61
Table 2B.	Summary of wrong answers in Section 2	65
Table 2C.	Summary of illegible answers in Section 2	67
Table 2D.	Summary of no answers in Section 2	69

Page

Table 3A. Summary of correct answers in Section 3 72

Table 3B. Summary of wrong answers in Section 3 74

Table 3C. Summary of part right, part wrong answers in Section 3 . . . 75

Table 3D. Summary of illegible answers in Section 3 76

Table 3E. Summary of no answers in Section 3 78

I. The Problem

1. What Measures Do People Know and Why? The study of usage has been a most profitable means of curriculum determination. It is based upon the social utility theory as applied to education. Knowledge should be functional and carry over into later life. If it does carry over, it will be used and therefore remembered. Hence it is possible to check on the value of certain phases of school work by discovering what work taught in the schools is still retained.

The present study is aimed at helping to determine the functional value of the teaching of denominate numbers and measures in the schools, through the discovery of what people know and the sources of their knowledge. Do children know some measures before they have studied them in school? Do they know other measures not studied in school, and if so, how have they acquired this knowledge? When measures are taught to children in the schools, how long are they remembered, and specifically what ones are remembered? What are the chief factors that determine effective learning and remembering of measures?

Do adults know the facts of denominate numbers and measures which they studied in school? Which ones do they remember? Is there any reason why they know these particular measures while others have been forgotten? Do they know other measures not taught in the schools, and if so, why?

I. The Problem

May one have a memory knowledge of simple measures facts such as feet and inches, without such knowledge being useful and practical for working purposes? For instance, what proportion of children or adults know four feet or eight inches objectively? Can they estimate or approximate simple distances, and if so, where has such ability come from,--from the schools or from experience or from other sources?

These are the types of questions that are being investigated in the present study. As will be explained in the third chapter, a method of study has been used that secures responses from children in grades three to twelve in eastern Massachusetts and from adults from different sections of the country. This will permit the study of variations due to schooling or maturity, and also variations due to environment. If these variations are such as to suggest causes, it is hoped that these in time may be referred back to school practices for approval or suggested changes.

Bearing upon the Curriculum. It becomes apparent, therefore, that the present study is in reality a curriculum study. What children and adults know about measures is not investigated for its own sake, but in order to secure help on what parts of the difficult and complicated work in denominate numbers and measures appearing in all arithmetics a half century ago and still retained in many text-books and tests, is really of value to children and adults.

II. Other Studies in the Field

A careful examination of the various studies on the usage of arithmetic shows some evidence bearing upon the purpose of this study. A brief review of these studies is given herewith in order to help in further defining the problem of this study and to help in its solution.

1. Wilson, 1909. At first, in eliminating the useless from arithmetic courses, reliance was placed upon the opinion of educational leaders. Wilson (11:6-8)*, in 1909, sent out a questionnaire to the business men of Connersville, Indiana, where he was the superintendent of schools, asking them to check on a list of arithmetic topics those for which they had had considerable use in the last six months and to cross out those for which they had had little or no use in the last six months. The fundamentals were not involved in this questionnaire at all; the topics involved were those of questionable value. The only weights or measures mentioned in the questionnaire were Troy weight, apothecaries' weight, foreign exchange and the surveyers' table. The replies of these business men indicated that most of them were in favor of eliminating all of these questionable topics from study in the

---

*The references thus appearing from time to time are to the bibliography on page 93. This reference is to No.11 in the bibliography, pages 6 to 8.

II. Other Studies in the Field

A careful examination of the various studies on the usage of arithmetic shows some evidence bearing upon the purpose of this study. A brief review of these studies is given herewith in order to help in further defining the problem of this study and to help in its solution.

1. Wilson, 1909. At first, in eliminating the useless from arithmetic courses, reliance was placed upon the opinion of educational leaders. Wilson (M:6-8)*, in 1909, sent out a questionnaire to the business men of Goshen, Indiana, where he was the superintendent of schools, asking them to check on a list of arithmetic topics those for which they had had considerable use in the last six months and to cross out those for which they had had little or no use in the last six months. The fundamentals were not involved in this questionnaire at all; the topics involved were those of questionable value. The only weights or measures mentioned in the questionnaire were Troy weight, apothecaries' weight, foreign exchange and the surveyors' table. The replies of these business men indicated that most of them were in favor of eliminating all of these questionable topics from study in the

---

*The references thus appearing from time to time are to the bibliography on page 93. This reference is to No.11 in the bibliography, pages 5 to 8.

schools. The other tables of weights and measures were not mentioned so one assumes that they were considered necessary.

2. Coffman and Jessup. Coffman and Jessup, in 1915, sent a similar questionnaire to superintendents of cities and to county superintendents in various parts of the country. This questionnaire asked for opinions as to which arithmetic topics in the list should be omitted and which should receive slight attention. Another section asked for opinions on subjects which should receive more attention than at present. The replies to this questionnaire indicated that the superintendents were overwhelmingly in favor of giving more attention to the fundamentals, with a considerable number in favor of giving more attention to social and economic phases of arithmetic. On the other hand, the recommendation was made by about half of the superintendents that such unprofitable subjects as alligation, cube root, unreal fractions, progression, and certain little used tables and facts in denominate numbers be either eliminated entirely or given less attention. Under the list of subjects about which there was a question of receiving less attention or eliminating entirely, appeared these weights and measures:

Apothecaries' weight, Troy weight, furlong, rod in square measure, drachm, quarter in avoirdupois weight, surveyor's tables, foreigh money, folding paper, reduction of more than two steps, the metric system. There were no measures mentioned in the group which were to be underscored for more attention.

3. Monroe, 1917. Monroe's method of finding what subjects in arithmetic are useful was to study four arithmetic textbooks (7:111-127). After collecting the problems in these books Monroe used his judgment alone to determine which problems might be used in some form of human activity. After collecting these problems, the author tabulated them according to arithmetical difficulties. No attempt was made to discover what processes were most used.

4. Wilson, 1918. A new type of approach to this problem was reported by Wilson in 1919 and called by him "The school-pupil-survey." This study was carried on through the co-operation of school teachers who directed the collecting of data by the children in the upper grades. These children brought in each day whatever figuring their fathers and mothers had had to do on the previous day, the entire problem being reported but not solved. This was continued for a period of two weeks, and was carried on in Kansas, Iowa and Minnesota in rural, town, and city districts. A total of 14,583 problems were collected from 4,068 persons of 155 different occupations.

The study showed that the figuring of adults, aside from vocational usage, is very simple. Most of the problems involved only the four fundamental processes. Beyond this the following appeared also: simple fractions, decimals involved in U. S. money, percentage, accounts and the common measures of buying and selling. This study showed that out of a total of 21,898, which represents the frequencies of all the processes reported, 707 were denominate numbers. This is only 3.2% of

the total frequency. These problems did not involve denominate numbers to the extent of adding, subtracting, multiplying, or dividing denominate numbers nor any reductions. The denominate numbers occurred only in such simple problems as: "My mother bought 3 yards of material at 25 cents a yard. What was the cost of the material?" In practically all cases the situation was as simple as that. The measure is the unit of sale.

Measurements are listed in Wilson's study (12) as follows: square measure, time measure, liquid measure, cubic measure, dry measure, linear measure, measuring, avoirdupois weight, carpeting, circular measure, plastering, papering, apothecaries' weight, Troy weight, but the details under these topics are not developed. Apparently only measures occurred in these various fields and not manipulation of measures.

5. Wise, 1919. A similar study was made by Wise (13), who used the same method but covered a wider area of the country. His findings and conclusions fully verify Wilson's study; i.e. the percentages of frequency of the various processes of arithmetic run about the same. In Wise's study however, while the frequency of occurance of denominate numbers was low, yet the problems where they did occur, in contrast to those found by Wilson, were complicated. In totalling the processes, he lists such subjects as board measure, carpeting, cord or wood measure, linear measure, cubic measure, dry measure, fencing, land measure, liquid measure, lumber, papering, hay in mow, hay in stack and mensuration. The percentage of the total of these measuring problems in Wise's study is 6.66. Some of these problems are quite complicated.

6. Williams, 1921. Williams (10) made a study of a college freshman chemistry textbook to discover what mathematics is needed in that study. He studied the context for the reading knowledge needed, and the problems for the computational knowledge needed. In the context, seventy-three denominate numbers were used 1937 times, and, of these, the degree was used 865 times. In the problems, 19 denominate number units were used 173 times, the most frequent being gross, 32 times; liter, 32 times; and degree, 17 times. Obviously this study has little value in determining what arithmetic should be taught in the elementary grades.

7. Woody, 1912. Woody (14) approached the subject from a vocational standpoint. He studied the sales slips of three large stores in Seattle, a wholesale and retail grocery store, a department store and a hardware store. Charters (1:231-236) made a similar study at about the same time, of sales slips in a department store. They both concluded that not much arithmetic is needed by salespeople. The most used operations are adding three- or four-place numbers with two, three or four addends; and multiplying a three-place number by a two- or three-place number. There is considerable multiplying by mixed numbers. There is no subtraction. Change is made by adding. There is no division. The common fractions are halves, fourths, thirds, and twelfths. Measures are always used singly, fractions being used to indicate a part of the whole. Measuring devices are used, as well as calculating machines, and weighing machines, and the suggestion is made that the children might well be made familiar with these. Discount is used considerably, but always in connection

with U. S. money, as are decimals.

8. Callaway, 1923. Mrs. Callaway (1:241-3) made a similar study of a freshman clothing textbook. She found that the denominate numbers occuring were those which occur in ordinary grade arithmetic, with two exceptions, the head and the skein. The frequency of occurrence of denominate numbers was 1723, and they are divided as follows: inch, 1122, dollar sign, 454; yard, 70; head, 14; year, 12; and all the rest, 12.

The two studies reported above in 6 and 8 are largely subjective in character and yet they served a very useful purpose in trying other methods for determining what should be taught in elementary mathematics. Gradually the objective studies of usage have been accepted as more scientific and more profitable.

9. Traniello, 1930. Traniello (9) made a study of the measures used in business houses of different types, both wholesale and retail, in Puerto Rico. He listed the entire stock of goods handled by six stores, as well as the goods purchased, with the measure or measures used in buying and selling each item. His conclusions are as follows:

"The six business enterprises studied have furnished a total of 415 items of purchase or sale. It will be apparent from the findings of the thesis and summary of figures that each transaction of purchase or sale of a given item has required, not a table, but only its own specific unit of measure.

"It is also an interesting fact that, so far as this study goes, out of a total of 415 listed items, only seven have

called for more than one unit of measure in effecting the transaction of purchase or sale. Each of the seven items requiring compound units has been listed in its appropriate place. They are exceptional, however, rather than the rule, for as has been shown, virtually each sales situation calls for one unit of measure, and that measure is the one that is best adapted to the situation."

The sale of doors illustrates the use of a compound unit in the above study. A door is labelled in feet and inches, thus 2-6 x 6-4 is the designation of size for a door, —2 ft. 6 in. wide by 6 ft. 4 in. high.

10. Louth, 1931. Louth (6) made a study of the units of measurement used in five different manufacturing plants, in Providence, Rhode Island. The industries studied were the Gorham Manufacturing Company, Silversmiths; the U. S. Finishing Company, textile finishing company; the Grinnell Company, manufacturers of fire extinguishers and other power piping and heating units; B. A. Ballow and Company, manufacturers of winding machines. Louth studied the denominate numbers used in buying raw materials and in selling the finished product as well as those used in manufacture. Among her conclusions, the following may be quoted as applicable to this study:

"Of the 18 different tables of weights and measures listed, only 12 were required in the five studied.

"Of the 93 possible units, the study has shown only 33 units used in these industries.

"Only 23% of the persons employed were using the 33 units of the 93 units included in the 18 tables.

"In using these units, the accuracy of the measurement is as important as the knowledge of the measurement itself.

"A table of measurement, as such, is seldom used in its entirety. Only one unit of the table is necessary as a rule.

"In the five industries studied, the inch was the most common unit of measurement, the pound (avoir) ranking second in frequency.

"A person using a measurement, uses it with a commodity and the fundamental point or basic fact is first, an understanding of that commodity. Handling the commodity with intelligence, therefore, comes first and knowledge of the unit of measurement follows."

11. Sala, 1934. Sala (18) made a similar study of four factories of New Britain, Connecticut. One of these, the manufacturers of ball bearings, was very highly specialized as to work and type of measurement. Some of Sala's conclusions follow:

"Out of the 67 possible units of the 11 tables used by the four companies in purchasing, manufacturing and selling, only 18 units were used.

"Over 61% of the persons employed did not need to use or understand any unit of measurement. In other words, 39% are experts who have been scientifically trained in technical schools

or in the factory. This percentage is unusually high due to the large number of experts in the Fafnir Ball Bearing Company. This industry requires a minute degree of accuracy in measurements on the part of most men. Omitting the Fafnir Company, the percentage not using measurements would equal 80."

To summarize, the findings of Wilson, Wise and Woody and other studies which were of the same general nature, the percentage of frequency of the processes in non-vocational figuring among adults seem to be about as follows:

Multiplication	35
Addition	25
Subtraction	12
Division	8
Fractions	9
Accounts	5
Percentage	4
	98

The total percentage of these processes is 98. The first four, that is the four fundamental processes, include 80% of the frequencies. From these figures it has been concluded that these four fundamental processes should be given attention by the use of drill until letter-perfect results have been obtained. Fractions, which in simple form have a frequency of 9%, should probably receive attention in the form of drill. Dalrymple (2), in an exhaustive study of several industries, attempted to find what fractions should receive attention. Fractions, when they do occur, are frequently associated with a measure.

Obviously denominate numbers and measures do not come into the list of much-used processes. Is it possible that the application of drill to denominate numbers and measures, as in the past, has been a mistake? If not drill material, should the tables and processes of denominate numbers and measures be placed in the classification of encyclopediac knowledge for reference only, or is there an intermediate possibility? The connection of the present study with past studies becomes obvious. By examining more carefully the status of knowledge of measures among children and adults it is hoped that further help may be secured on our main question, a question that has been anticipated and partly solved by earlier studies.

III. Method of Study

1. How Questions Were Chosen.

The questionnaire method was used in this study. The questionnaire was cast in the form of a group test. The items of the test were not chosen at random. The selection of items was on the basis of what was thought would show something significant. Various forms were tried. The early forms were given to different classes of students at Boston University and Wellesley College and to some public school groups, over a period of about a year and a half. Some items were added and others eliminated until the present form was arrived at. This is shown in Exhibit 1, page 14.

2. Make-up of Questionnaire.

There are three parts to the test, each designed to bring out a different type of knowledge with respect to measures. The first part asks in what unit each of twenty different commodities is sold in retail trade. The approach is a life approach, designed to discover a knowledge of measures based upon the experience of buying. Does early experience bring some knowledge of measures to young children, with or without the aid of the school? One would naturally expect this knowledge to develop with increasing age.

Many of the commodities are very common ones, such as gasoline, milk, meat, fish, oranges, and bread. Others are bought and sold in the rural sections commonly, but not in the city districts, such as farm land, wheat, and oats. Others,

III. Method of Study

1. How Questions Were Chosen.

The questionnaire method was used in this study. The questionnaire was cast in the form of a group test. The items of the test were not chosen at random. The selection of items was on the basis of what was thought would show something significant. Various forms were tried. The early forms were given to different classes of students at Boston University and Wellesley College and to some public school groups, over a period of about a year and a half. Some items were added and others eliminated until the present form was arrived at. This is shown in Exhibit I, page 14.

2. Make-up of Questionnaire.

There are three parts to the test, each designed to bring out a different type of knowledge with respect to measures. The first part asks in what unit each of twenty different commodities is sold in retail trade. The supposition is a life supposition, designed to discover a knowledge of measures based upon the experience of buying. Does early experience bring some knowledge of measures to young children, with or without the aid of the school? One would naturally expect this knowledge to develop with increasing age.

Many of the commodities are very common ones, such as gasoline, milk, meat, fish, oranges, and bread. Others are bought and sold in the rural sections commonly, but not in the city districts, such as farm land, wheat, and oats. Others,

Exhibit 1. Showing the Blank Form used for gathering data on knowledge of measures at different maturity levels and in different sections of the country.

Name_____Grade____Age___Town_____

Denominate Numbers and Measures. Test Form I.

(Answer as many as you can.)

Sec. 1. In what units are the following articles sold in general or retail trade? (The answer is given for the first one.)

a. butter (pound)	h. fish_____	o. oranges_____
b. gasoline_____	i. apples_____	p. lettuce_____
c. farm land_____	j. corn_____	q. bread_____
d. milk_____	k. wheat_____	r. wool_____
e. potatoes_____	l. cotton lint___	s. nails_____
f. dress goods____	m. sugar_____	t. wood_____
g. meat_____	n. eggs_____	u. oats_____

Sec. 2. Give heights, distances, weights, etc.

a. The height of the dining-room table_____
b. The width of a full-size bed_____
c. The height of a ceiling of a living-room_____
d. The width of a side-walk in residence parts of a city_____
e. The distance between rails of a railroad_____

Sec. 3. Answer these questions.

a. How many inches in a foot? _____
b. How many ounces in a pound? _____
c. How many inches in a yard? _____
d. How many acres in a quarter-section? _____
e. How many quarts in a gallon? _____

f. About how many pounds in a bale of cotton? _____
g. How many dozen of eggs in a crate? _____
h. How many pennyweight in an ounce? _____
i. How many barley corns in an inch? _____
j. How many pounds in a bushel of wheat? _____
k. How many cubic inches in a cubic foot? _____

Exhibit 1. Showing the Blank Form used for gathering data on knowledge of measures at different maturity levels and in different sections of the country.

Name _____ Grade ____ Age ____ Town _____

Denominate Numbers and Measures. Test Form 1.

(Answer as many as you can.)

Sec. 1. In what units are the following articles sold in general or retail trade? (The answer is given for the first one.)

a. butter (pound) h. fish _____ o. oranges _____
b. gasoline _____ i. apples _____ p. lettuce _____
c. farm land _____ j. corn _____ q. bread _____
d. milk _____ k. wheat _____ r. wool _____
e. potatoes _____ l. cotton lint _____ s. nails _____
f. dress goods _____ m. sugar _____ t. wood _____
g. meat _____ n. eggs _____ u. oats _____

Sec. 2. Give heights, distances, weights, etc.

a. The height of the dining-room table _____
b. The width of a full-size bed _____
c. The height of a ceiling of a living-room _____
d. The width of a side-walk in residence parts of a city _____
e. The distance between rails of a railroad _____

Sec. 3. Answer these questions.

a. How many inches in a foot? _____
b. How many ounces in a pound? _____
c. How many inches in a yard? _____
d. How many acres in a quarter-section? _____
e. How many quarts in a gallon? _____

f. About how many pounds in a bale of cotton? _____
g. How many dozen of eggs in a crate? _____
h. How many pennyweight in an ounce? _____
i. How many barley corns in an inch? _____
j. How many pounds in a bushel of wheat? _____
k. How many cubic inches in a cubic foot? _____

such as wool and cotton lint, are used most in specific sections of the country. Two commodities bought by a more limited number of people are dress goods and nails.

The second part asks for an estimate of several distances. These distances were chosen because practically everyone has an opportunity of seeing and experiencing them very often, and if he knows feet and inches and has formed the habit of estimating (or using knowledge objectively) he should be able to give the distances with reasonable accuracy. What percentage of children and of adults can do this?

Part three asks questions of the type: "How many inches in a foot?" Many of these were studied in school. Others, such as 3-f, pounds in a bale of cotton; 3-g, dozen eggs in a crate; and 3-i, barley corns in an inch, were not, and a knowledge of them would be gained almost certainly only through experience outside of school.

3. To Whom Questionnaire Was Given.

The test was given to 2,817 people distributed among grade children, high school children and adults in different sections of the country, as follows:

3. To What Questionnaire Was Given.

The test was given to 3,007 people distributed among grade children, high school children and adults in different sections of the country, as follows:

Grade Schools

3d Grade				
Quincy	(boys)	54		
"	(girls)	40	94	
4th Grade				
Everett	(boys and girls)	41		
Braintree	(boys and girls)	9		
Quincy	(girls)	56		
"	(boys)	58		
Watertown	(")	47		
"	(girls)	46	257	
5th Grade				
Everett	(boys and girls)	90		
Arlington	(" " ")	30		
Braintree	(" " ")	8		
Quincy	(girls)	57*		
"	(boys)	53		
Watertown	(boys and girls)	84	322	(or 321)
6th Grade				
Everett	(boys and girls)	103		
Braintree	(" " ")	7		
Arlington	(" " ")	52		
Watertown	(" " ")	87		
Quincy	(boys)	40		
"	(girls)	50		
Belmont	(boys)	16		
"	(girls)	22**		
New Bedford	(boys and girls)	47	424	(or 423, or 422)
	Grade School Total		1097	(or 1095)

*One drops out after Sec. 2 and in Sec. 3 there are 56 instead of 57.
**One drops out after (1-f) leaving only 21.

Grade School

3d Grade

Quincy	(boys)	41	
"	(girls)	50	91

4th Grade

Everett	(boys and girls)	41	
Braintree	(boys and girls)	9	
Quincy	(girls)	25	
"	(boys)	28	
Watertown	(")	47	
"	(girls)	46	257

5th Grade

Everett	(boys and girls)	90	
Arlington	(" " ")	70	
Braintree	(" " ")	8	
Quincy	(girls)	57*	
"	(boys)	53	
Watertown	(boys and girls)	54	322 (or 321)

6th Grade

Everett	(boys and girls)	103	
Braintree	(" " ")	7	
Arlington	(" " ")	52	
Watertown	(" " ")	87	
Quincy	(boys)	40	
"	(girls)	50	
Belmont	(boys)	16	
"	(girls)	22**	
New Bedford	(boys and girls)	42	429 (or 423 or 425)

Grade School Total 1097 (or 1095)

*One drops out after Sep. 2 and in Sec. 3 there are 55 instead of 57.

**One drops out after (1-4) leaving only 21.

High School

Junior High School

7th Grade

New Bedford	(Pupils)		73	
Watertown	(")	52 boys, 46 girls	98	
Quincy	(")	48 boys, 46 girls	94	265

8th Grade

New Bedford	(Pupils)		67	
Watertown	(")		104	
Quincy	(")		85	256

9th Grade

New Bedford	"		81	
Warren	"		45	126
		Junior High School Total		647 647

Senior High School

10th Grade

Warren	(pupils)		40	
New Bedford	(")		124	164

11th Grade

Warren	(Pupils)		24	
New Bedford	"		37	61

12th Grade

Warren	(Pupils)		23	
New Bedford	"		66	89
		Senior High School Total		314 314
		High School Totals		961

Adults

New England			
Boston University Students		228	
" " "	(Women)	21*	
" " "	(Men)	20*	
Arlington Teachers		12	
Boston "	(Women)	25*	
" "	(Men)	4*	
		310	310 (or 240)
Middle West			
Indiana St. Teachers Col.	(Women)	11	
" " " "	(Men)	20	
" " " "	(Both)	25	
Indiana University	(Men)	112	
" "	(Women)	23	
Iowa State Teachers Col.	(Men)	26	
" " " "	(Women)	115	
		332	332
Southern			
Louisiana University	(Students)	11	
" "	(Women)	19	
" "	(Men)	47	
		77	77
Pacific Coast			
University of California	(Students)	42	42
	Total		761 (Or 691)

* These 70 papers were of another form so that they drop out except for 1-c. 1-k, 1-l, etc. and the total in New England becomes 240.

Adults

New England

Boston University Students		228
" " "	(Women)	21*
" " "	(Men)	20*
Arlington Teachers		12
Boston "	(Women)	24*
" "	(Men)	6*
		310 (or 290)

Middle West

Indiana St. Teachers Col.	(Women)	11
" " " "	(Men)	20
" " " "	(Both)	25
Indiana University	(Men)	112
" "	(Women)	23
Iowa State Teachers Col.	(Men)	20
" " "	(Women)	118
		332

Southern

Louisiana University	(Students)	11
" "	(Women)	19
	(Men)	47
		77

Pacific Coast

University of California	(Students)	42
	Total	761 (or 691)

* These 70 papers were of another form so that they drop out except for 1-c, 1-f, 1-i, etc. and the total in New England becomes 290.

The first large group of people to whom the questionnaire was sent was school children. It was intended that the tests not be given to children below the fourth grade. But, through a misunderstanding, they were given to a small group of third grade children and these were included.

All of these school children are in cities or towns near Boston. They belong therefore to a city environment in New England. It is to be regretted that the numbers in grades 11 and 12 are so small. Some of the papers were kept separately by sexes but a good many had been scored before this division was made.

All of the adults to whom the tests were given are either teachers of college students, and they constitute a highly selective group with an education much above the average adult.

The attempt was made in this adult group to give the tests to people of the South, the Middle West and the Pacific Coast Region, as well as to those in New England. The returns however from Louisiana and California Universities were very small, so that the comparison can be made to advantage only between New England and the Middle West since the numbers from the other sections of the country are not large enough to be significant. Furthermore the question as to where the tested person was born brought out the fact that the California students do not represent that section of the country very well. Of the 40 California students who gave their birth place, 85% were born outside of California, and 47½% were from the Middle West.

The adults taking the test outside of New England were asked to indicate where they had lived, their father's occupation and various occupations they themselves had engaged in. This was in order to account for the way in which their experience had shaped their knowledge. They were asked to give their names or indicate sex. In the California and Louisiana papers however this last bit of information was pretty largely omitted, so that it was impossible to make the distinction between sexes for those papers. This was true also of some of the returns from the Middle West. The New England tests were for the most part given before it was decided to try to separate the sexes.

It appeared when considerable of the scoring of the papers had been done, that several changes in the form of the questionnaire were desirable. In the first place, it was very difficult to determine how the experience of the person answering had affected his knowledge of the measures. Furthermore, the items seem more numerous than is necessary. So, a new form was made. (See Exhibit 2*.) This was given to a total of seventy adults, but the study was already so large as to involve too much work so no more questionnaires were sent out**. These 70 papers are included in the study with the others, and explain the different totals on some items.

---

*In case another similar study is undertaken, the use of Form II as shown in Exhibit 2 is recommended.

**This excess of labor was partly obviated by having certain phases of the work done by others, all students at Boston University, through the cooperation of the advising professor who arranged appropriate hours of credit according to the task undertaken. Students thus cooperating were: Gertrude Twombley, Margaret Richardson and Philomena Catinella.

The adults taking the test outside of New England were asked to indicate where they had lived, their father's occupation and various occupations they themselves had engaged in. This was in order to account for the way in which their experience had shaped their knowledge. They were asked to give their names on indicate sex. In the California and Louisiana papers however this last bit of information was pretty largely omitted, so that it was impossible to make the distinction between sexes for those papers. This was true also of some of the returns from the Middle West. The New England tests were for the most part given before it was decided to try to separate the sexes.

It appeared when considerable of the scoring of the papers had been done, that several changes in the form of the questionnaire were desirable. In the first place, it was very difficult to determine how the experience of the person answering had affected his knowledge of the measures. Furthermore, the items seem more numerous than is necessary. So, a new form was made. (See Exhibit 2*.) This was given to a total of seventy adults, but the study was already so large as to involve too much work to do more questionnaires were sent out**. These 70 papers are included in the study with the others, and explain the different totals on some items.

---

*In case another similar study is undertaken the use of Form II as shown in Exhibit 2 is recommended.

**This excess of labor was partly obviated by having certain phases of the work done by others. All students at Boston University through the cooperation of the advising professor who arranged appropriate hours of credit according to the task undertaken. Students thus cooperating were: Gertrude Twombly, Margaret Richardson and Philomena Catinella.

Exhibit 2. Denominate Numbers and Measures. Test Form II

Name_____Boy___or Girl___Age_____
Town or City_____Building_____Grade_____
In what other states have you lived?_____
Ever lived on a farm?_____Or worked in a st ore?_____
Father's occupations (please list all he has ever engaged in, even if he is not living now)_____
Lines of work in which you have engaged_____

In answering the following, please indicate after each answer a letter, as follows, showing how you knew: (a) guessed; (b) remembered from school; (c) have taught it; (d) remembered from reading; (e) had experience which fixed it in mind. If (e), indicate specific experience: as, "worked on farm"; or, "have packed eggs".

1. In what units are the following articles sold in general or retail trade? (The answer is given for the first one.)

a. butter	pound	(e)	Purchasing
b. farm land			
c. wheat			
d. cotton lint			
e. eggs			
f. wool			
g. nails			
h. wood			

2. Give required dimension, followed by letter a, b, c, d, or e:

a. Height of dining-room table_____
b. Height of ceiling of living-room_____
c. Distance between rails of railroad_____

3. Answer these questions, followed by letter a, b, c, d, or e:

a. How many inches in a foot?_____
b. How many acres in a quarter-section?_____
c. How many pounds in a bale of cotton?_____
d. How many dozens of eggs in a crate?_____
e. How many pounds in a bushel of wheat?_____
f. How many pennyweights in an ounce?_____
g. How many furlongs in a mile?_____

Exhibit 2. Denominate Numbers and Measures. Test Form II

Name _____ Boy or Girl ____ Age _____
Town or City _____ Building _____ Grade _____
In what other states have you lived? _____
Ever lived on a farm? _____ Or worked in a store? _____
Father's occupations (please list all he has ever engaged in, even if he is not living now) _____
Lines of work in which you have engaged _____

In answering the following, please indicate after each answer a letter, as follows, showing how you knew: (a) guessed; (b) remembered from school; (c) have taught it; (d) remembered from reading; (e) had experience which fixed it in mind. If (e), indicate specific experience: as, "worked on farm"; or, "have packed eggs".

1. In what units are the following articles sold in general or retail trade? (The answer is given for the first one.)

a. butter pound (e) Purchasing _____
b. farm land _____
c. wheat _____
d. cotton lint _____
e. eggs _____
f. wool _____
g. nails _____
h. wood _____

2. Give required dimension, followed by letter a, b, c, d, or e:

a. Height of dining-room table _____
b. Height of ceiling of living-room _____
c. Distance between rails of railroad _____

3. Answer these questions, followed by letter a, b, c, d, or e:

a. How many inches in a foot? _____
b. How many acres in a quarter-section? _____
c. How many pounds in a bale of cotton? _____
d. How many dozens of eggs in a crate? _____
e. How many pounds in a bushel of wheat? _____
f. How many pennyweights in an ounce? _____
g. How many furlongs in a mile? _____

Having gathered the data, the next step was to devise plans for statistical treatment, in order that interpretation might be given.

IV. The Data and Its Interpretation

1. Statistical Treatment. The total number of papers to be dealt with was 2,817. Interpretation of so large a number necessitated statistical treatment. Nor was it possible in any way to give a general summary of all of the items of the questionnaire. Each item had to receive separate treatment. For instance, Item b, gasoline, under Section 1 of the questionnaire (shown in Exhibit 1, page 14.) was given complete statistical treatment. The first step was to go through the papers and get all of the various answers as to how gasoline is sold. The form of summary for Item 1-b, gasoline, is shown in Exhibit 3, page 24. At the left there appears all of the various answers as to how gasoline is sold, a total of twenty. At the top is shown the classification of the pupils and adults answering the questionnaire. This classification shows as much of detail as is possible,-grade, sex, geographical location.

After the data on an item had been spread out in table form for each item, as just indicated, the next step was to summarize the table by securing totals and other items of value. In Section 1, the totals are broken up into: (a) Right answers, (b) Part right, part wrong answers, (c) Wrong answers, (d) Illegible answers, (e) No answer, (f) Not a unit of measure, and (g) The most common unit of measure. (See summary for gasoline at the foot of the sheet Exhibit 3, page 24).

The items under Section 1 of the questionnaire, totalling twenty, were thus summarized at the bottom of each

IV. The Data and Its Interpretation

Exhibit 3.

Summary of 1 b. Gasoline

Column groups (left to right): 3rd Grade · 4th Grade · 5th Grade · 6th Grade · 7th Grade · 8th Grade · 9th Grade · 10th Grade · 11th Grade · 12th Grade · B.U. · Boston Teachers · Ind. St. T.C. · Ind. U. Iowa · Louisiana Un. · Adults

Columns: Boys, Girls, Total (Quincy Schools) · Everett · Braintree · Boys, Girls, Total (Quincy Schools) · Boys, Girls, Total (Watertown Schools) · Fourth Grade Totals · Everett · Arlington · Braintree · Boys, Girls, Totals (Quincy Schools) · Watertown · 5th Grade Totals · Everett · Braintree · Arlington · Watertown · Boys, Girls, Total (Quincy Schools) · Boys, Girls, Totals (Watertown Schools) · New Bedford · 6th Grade Totals · Grade Totals · New Bedford · Boys, Girls, Total (Watertown Schools) · Boys, Girls, Total (Quincy Schools) · 7th Grade Totals · New Bedford · Boys, Girls, Total (Watertown Schools) · Boys, Girls, Total (Quincy Schools) · 8th Grade Totals · New Bedford · Warren · 9th Grade Totals · Junior High Totals · Warren · New Bedford · 10th Grade Totals · Warren · New Bedford · 11th Grade Totals · Warren · New Bedford · 12th Grade Totals · Senior High Totals · Boston Un. Students · Boston Uni. Women · Boston Uni. Men · Boston Teachers Men · Boston Teachers Women · Arlington Teachers · New England Totals · Indiana St. T.C. Women · Indiana St. T.C. Men · Indiana St. T.C. Totals · Indiana Uni. Men · Indiana Uni. Women · Iowa St. T. Col. Men · Iowa St. T. Col. Women · Middle West Totals · Louisiana Uni. Women · Louisiana Uni. Men · Louisiana Uni. Women · Louisiana Uni. Totals · Out of Coll. Grad. Women · Adult Totals

Response	Entries (left to right across columns)
1 caftiena	1 1 · 1 · 1
2 can	1 · 1 1
3 canena.	1 · 1 · 1
4 car	1 1 1 · 1
5 gallons	50 36 86 · 59 9 57 53 110 47 45 92 · 250 · 87 30 8 53 56 109 81 · 317 · 100 7 52 86 40 49 88 16 22 38 46 · 419 · 1070 · 71 52 44 96 47 45 92 · 259 · 66 54 49 103 47 37 84 · 253 · 79 45 · 124 · 636 · 40 124 · 164 · 22 37 · 59 · 23 66 · 89 · 312 · 221 · 12 · 239 · 10 20 26 111 28 26 113 · 320 · 11 46 19 78 42 · 686
6 gallon, quart	1 · 1 · 1 · 1 1 · 1 · 1 · 1 2
7 gas	1 · 1 · 1 · 1 · 1 · 1 1 · 1 · 5 · 1 1 · 1
8 gasoline	1 1 · 1
9 general	1 · 1 · 1
10 milk	1 1 · 1 · 1
11 molasses	1 · 1 · 1 · 1 · 1
12 cal	1 1 · 1 · 1
13 pint	1 · 1 · 1
14 pound	1 1 · 1
15 quart	1 · 1 · 1 · 1 · 1 · 1 1 2 · 4 · 2 · 1 1 · 3 · 9 · 2 · 1 1 · 3 · 1 · 1 · 1 · 1 · 1 · 5 · 1 · 1 · 1
16 10¢	1 · 1 · 1
17 5 gallon lot	1 · 1
18 misunderstood	1 · 1 · 1
19 illegible	1 2 · 3 · 3 · 1 · 1
20 no answer	1 1 · 2 · 1 1 · 1 · 1 · 1 · 1 · 1 · 5 · 1 · 1 · 1
Total	54 40 94 · 61 9 58 56 114 47 46 93 · 257 · 90 30 8 53 57 110 89 · 322 · 103 7 52 87 40 50 90 16 22 38 47 · 424 · 1097 · 73 52 48 99 47 46 94 · 265 · 67 55 49 104 47 37 85 · 256 · 81 45 · 126 · 647 · 40 124 · 164 · 24 37 · 61 · 23 66 · 89 · 314 · 229 · 12 · 240 · 11 20 25 112 23 26 115 · 332 · 11 47 19 77 42 · 691

Summary	Values
a. Right: 5, 6, 15, 17	87 · 252 · 321 · 420 1084 · 262 · 255 · 126 643 · 164 · 60 · 89 313 · 239 · 329 · 77 42 687
b. Part right, part wrong: none	0 · 0 · 0 · 0 0 · 0 · 0 · 0 0 · 0 · 0 · 0 0 · 0 · 0 · 0 0 0
c. Wrong: 1-4, 7-14, 16	2 · 4 · 0 · 3 9 · 3 · 1 · 0 4 · 0 · 0 · 0 0 · 1 · 2 · 0 0 3
d. Illegible: 18, 19	3 · 0 · 0 · 0 3 · 0 · 0 · 0 0 · 0 · 0 · 0 0 · 0 · 1 · 0 0 1
e. No answer: 20	2 · 1 · 1 · 1 5 · 0 · 0 · 0 0 · 0 · 1 · 0 1 · 0 · 0 · 0 0 0
f. Not a unit of Measure: 1, 3, 4, 7-12, 16	2 · 4 · 0 · 2 8 · 3 · 1 · 0 4 · 0 · 0 · 0 0 · 0 · 1 · 0 0 1
g. The most common unit: 5, 16, 17	86 · 251 · 317 · 417 1078 · 259 · 254 · 125 638 · 164 · 59 · 89 312 · 239 · 329 · 77 42 687

Summary of 1 g. Meat

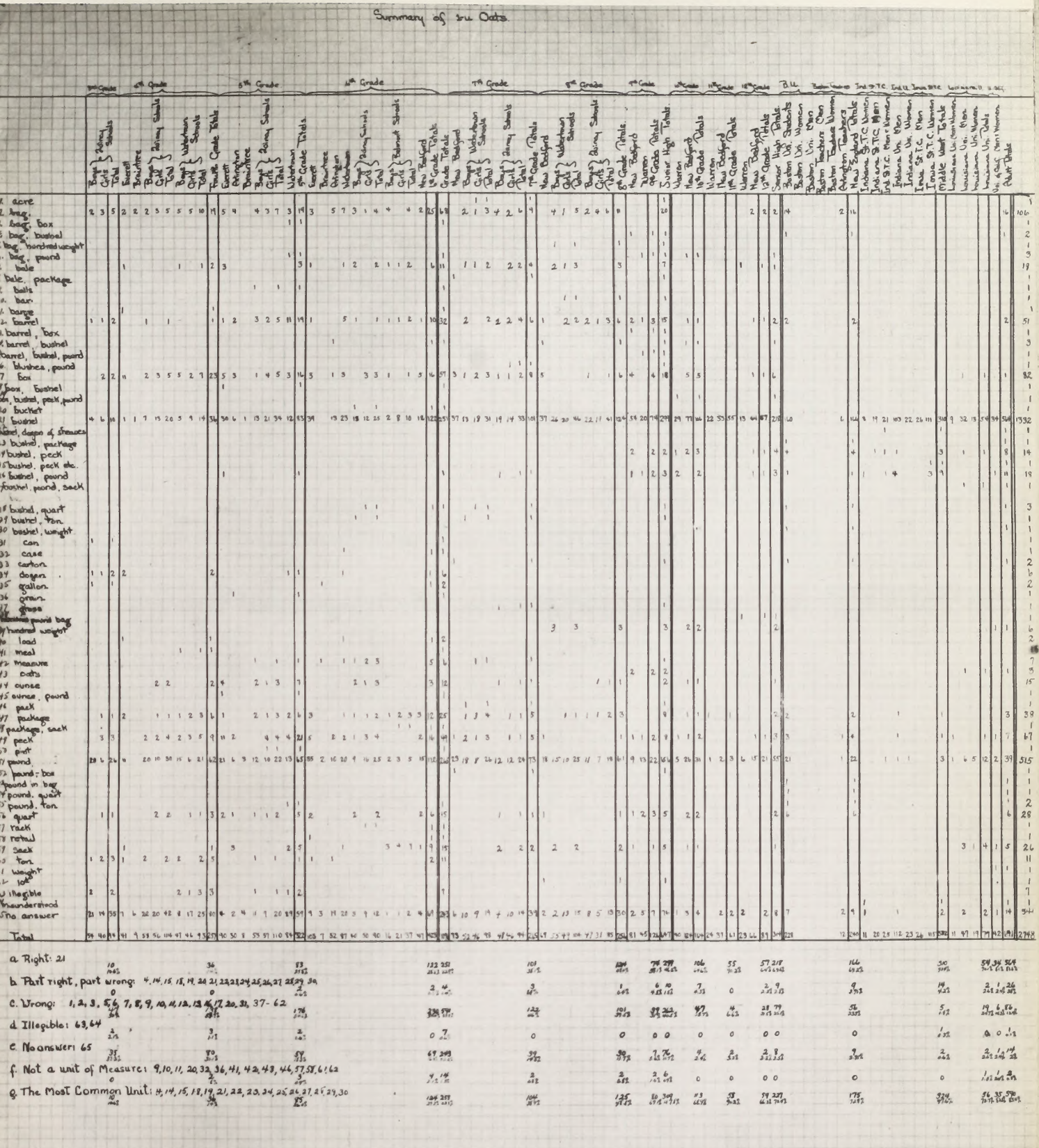
Response	Entries (left to right across columns)
1. apiece, pound	1 · 1 · 1
2. bls.	1 1 · 1 · 1
3. cut or pound	1 · 1 · 1
4. coal	1 1 · 1 · 1
5. foot	1 · 1 · 1
6. half pound	1 · 1 · 1
7. half pound, pound	1 · 1 · 1
8. jar	
9. ounce	1 1 · 2 · 2 2 · 2 · 1 · 1 · 1 1 1 · 2 · 9
10. ounce, pound	1 · 1 · 1
11. paper	1 · 1 · 1 1 · 1 · 2
12. papper	1 1 · 1 · 1
13. pound	45 30 75 · 36 9 53 49 102 42 43 85 · 234 · 86 30 7 50 56 106 81 · 310 · 102 7 51 85 38 50 88 16 21 37 46 · 461 · 1082 · 72 51 46 97 47 46 94 · 215 · 66 53 49 104 47 37 85 · 255 · 81 45 · 126 · 644 · 40 123 · 163 · 24 36 · 60 · 23 66 · 89 · 312 · 226 · 12 · 239 · 10 20 25 112 23 26 115 · 331 · 11 46 19 76 41 · 686
14. pound, slice	1 · 1 · 1
15. retail	1 · 1 · 1
16. rounds	1 1 · 1 · 1
17. slices	1 · 1 · 1 · 2 · 2
18. store	1 1 · 1 · 1
19. story	1 1 · 1 · 1
20. ton	1 · 1 · 1
21. weight	1 · 1
22. 5 or 6 pounds	1 · 1 · 1 · 1 · 1 · 1
23. 50¢	1
24. misunderstood	1 · 1 · 1
25. no answer	9 9 · 14 · 2 · 3 6 9 1 2 5 · 14 · 2 · 1 2 1 3 5 · 9 · 1 1 1 · 1 · 1 · 4 · 41 · 1 1 · 1 1 · 2 · 1 1 · 1
Total	54 40 94 · 41 9 58 56 114 47 46 93 · 257 · 90 30 8 53 57 110 89 · 322 · 103 7 52 87 40 50 90 16 21 37 47 · 423 · 1096 · 73 52 46 98 47 46 94 · 215 · 67 55 49 104 47 37 85 · 256 · 81 45 · 126 · 647 · 40 124 · 164 · 24 37 · 61 · 23 66 · 89 · 314 · 228 · 12 · 240 · 11 20 25 112 23 26 115 · 332 · 11 47 19 77 42 · 691

Summary	Values
a. Right: 7, 13	75 · 235 · 310 · 416 1039 · 263 · 255 · 126 644 · 163 · 60 · 89 312 · 238 · 331 · 76 41 686
b. Part right, part wrong: 1, 3, 10, 14	0 · 1 · 0 · 0 1 · 1 · 0 · 0 1 · 0 · 0 · 0 0 · 2 · 0 · 0 0 2
c. Wrong: 2, 4-6, 8, 9, 11, 12, 15-23	5 · 10 · 3 · 3 21 · 1 · 1 · 0 2 · 0 · 0 · 0 0 · 0 · 0 · 0 1 1
d. Illegible: 24	0 · 0 · 0 · 0 0 · 0 · 0 · 0 0 · 0 · 0 · 0 0 · 0 · 1 · 0 0 1
e. No answer: 25	14 · 14 · 9 · 4 41 · 0 · 0 · 0 0 · 1 · 1 · 0 2 · 0 · 0 · 1 0 1
f. Not a unit of Measure: 2, 4, 11, 12, 15, 16, 18, 19, 21, 23	3 · 3 · 1 · 1 8 · 1 · 1 · 0 2 · 0 · 0 · 0 0 · 0 · 0 · 0 1 1
g. The most common unit: 1, 3, 6, 7, 10, 13, 14, 22	77 · 239 · 311 · 416 1050 · 264 · 255 · 126 645 · 163 · 60 · 89 312 · 240 · 331 · 76 41 688

V

Exhibit 4.

Summary of 211 Oats.



1. acre	
2. bag.	106
3. bag, box	
4. bag, bushel	2
5. bag, hundredweight	
6. bag, pound	3
7. bale	19
8. bale, package	
9. balls	
10. bar	
11. barge	1
12. barrel	51
13. barrel, box	
14. barrel, bushel	3
15. barrel, bushel, pound	
16. blushes, pound	
17. box	82
18. box, bushel	
19. box, bushel, peck, pound	
20. bucket	
21. bushel	1332
22. bushel, degree of sheaves	
23. bushel, package	
24. bushel, peck	14
25. bushel, peck etc.	
26. bushel, pound	19
27. bushel, pound, sack	
28. bushel, quart	3
29. bushel, ton	
30. bushel, weight	
31. can	
32. case	
33. carton	2
34. dozen	6
35. gallon	2
36. grain	
37. grape	
38. hundred pound bag	
39. hundred weight	6
40. load	2
41. meal	15
42. measure	7
43. oats	3
44. ounce	15
45. ounce, pound	
46. pack	
47. package	39
48. package, sack	
49. peck	67
50. pint	
51. pound	315
52. pound; box	
53. pound in bag	
54. pound, quart	
55. pound, ton	2
56. quart	28
57. rack	
58. retail	
59. sack	24
60. ton	11
61. weight	
62. lot	1
63. illegible	1
64. misunderstood	1
65. no answer	344
Total	2748

a. Right: 21

b. Part right, part wrong: 4, 14, 15, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30

c. Wrong: 1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 16, 17, 20, 31, 37-62

d. Illegible: 63, 64

e. No answer: 65

f. Not a unit of Measure: 9, 10, 11, 20, 32, 36, 41, 42, 43, 46, 57, 58, 61, 62

g. The Most Common Unit: 4, 14, 15, 18, 19, 21, 22, 23, 24, 25, 26, 27, 29, 30

Exhibit 5.

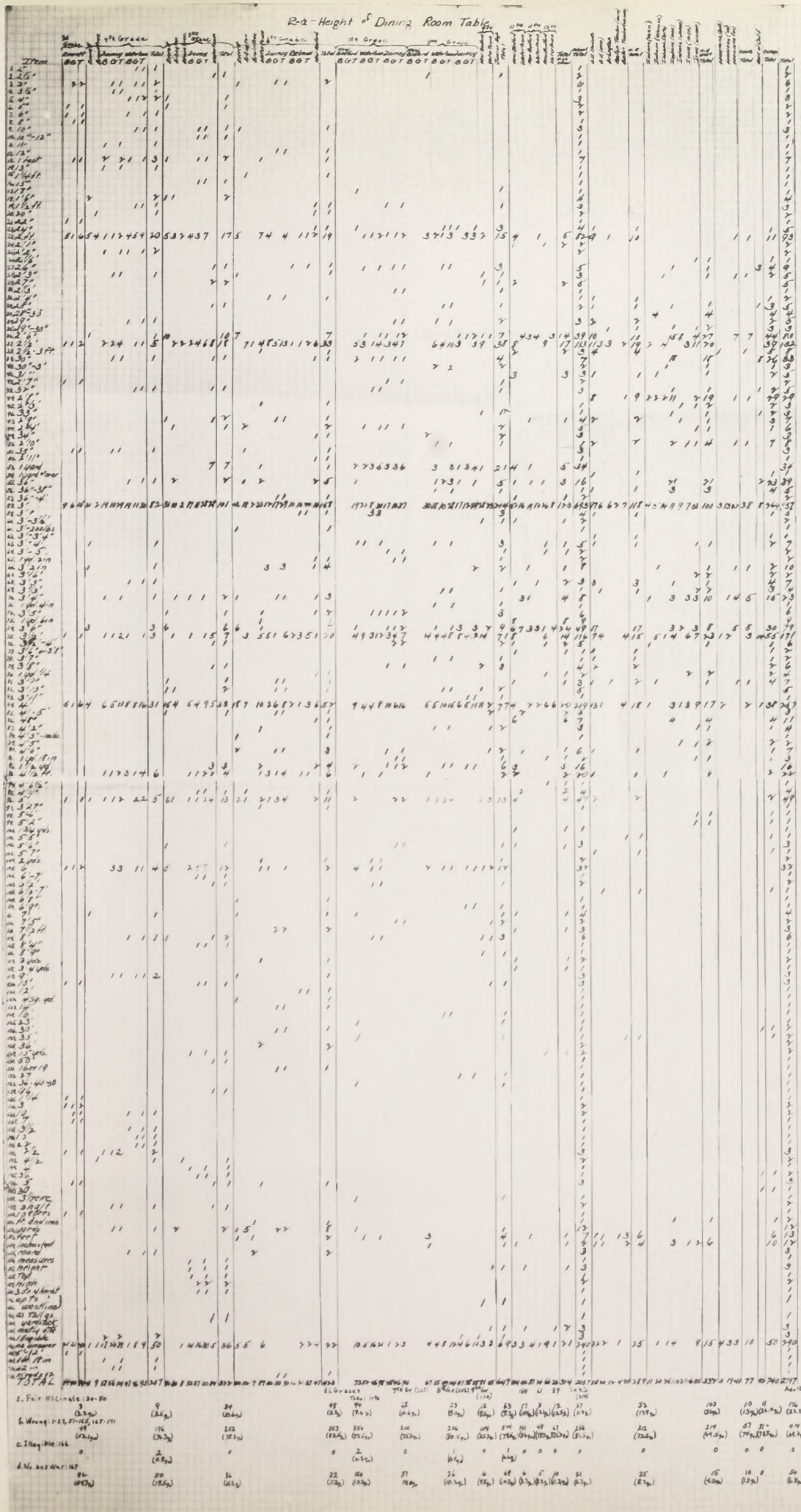
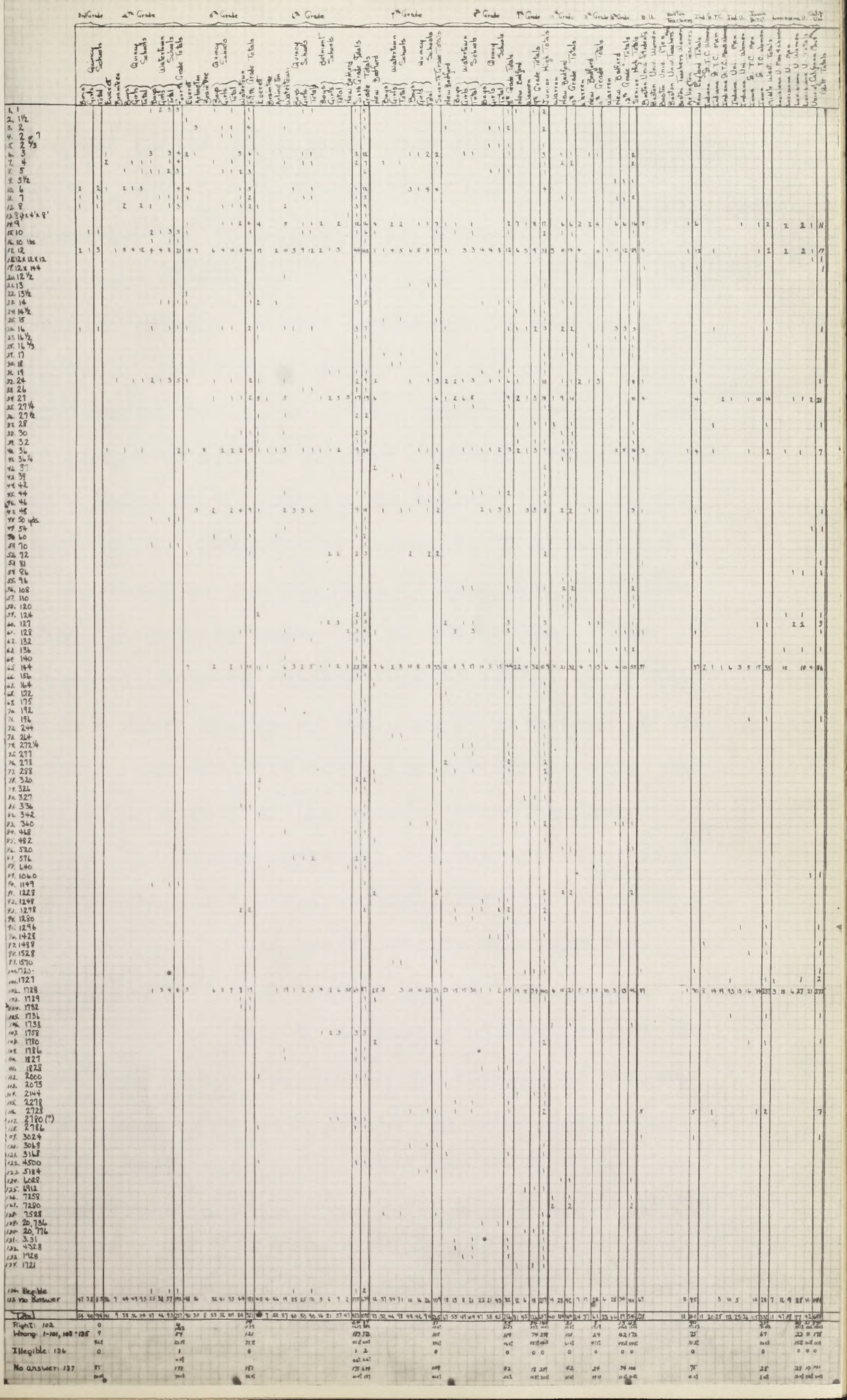


Exhibit 6.

Summary of 3rd. Cube inches in a cubic foot



	Total	Right: 102	Wrong: 1-101, 103-135	Illegible: 136	No answer: 137
1. 1	5	5			
2. 1½	1	1			
3. 2	5	5			
4. 2 5/7	1	1			
5. 2 2/3	1	1			
6. 3	12	12			
7. 4	7	7			
8. 5	6	6			
9. 5½	1	1			
10. 6	13	13			
11. 7	5	5			
12. 8	9	9			
13. 8 ft x 4' x 8'	1	1			
14. 9	16	16			
15. 10	6	6			
16. 10 lbs	1	1			
17. 12	144	144			
18. 12 x 12 x 12	1	1			
19. 12 x 144	1	1			
20. 12½	1	1			
21. 13	1	1			
22. 13½	1	1			
23. 14	5	5			
24. 14½	1	1			
25. 15	1	1			
26. 16	7	7			
27. 16½	1	1			
28. 16 2/3	1	1			
29. 17	1	1			
30. 18	1	1			
31. 19	1	1			
32. 24	29	29			
33. 26	1	1			
34. 27	19	19			
35. 27½	6	6			
36. 27 ½	2	2			
37. 28	1	1			
38. 30	3	3			
39. 32	1	1			
40. 36	29	29			
41. 36½	1	1			
42. 37	2	2			
43. 39	1	1			
44. 42	1	1			
45. 44	1	1			
46. 46	1	1			
47. 48	19	19			
48. 50 yds	1	1			
49. 54	1	1			
50. 60	1	1			
51. 70	1	1			
52. 72	5	5			
53. 81	1	1			
54. 96	1	1			
55. 96	1	1			
56. 108	2	2			
57. 110	1	1			
58. 120	1	1			
59. 124	2	2			
60. 127	3	3			
61. 128	3	3			
62. 132	1	1			
63. 136	1	1			
64. 140	1	1			
65. 144	286	286			
66. 156	1	1			
67. 164	1	1			
68. 172	1	1			
69. 175	1	1			
70. 192	1	1			
71. 196	1	1			
72. 244	1	1			
73. 264	1	1			
74. 272¼	1	1			
75. 277	1	1			
76. 278	2	2			
77. 288	2	2			
78. 320	2	2			
79. 324	1	1			
80. 327	1	1			
81. 336	1	1			
82. 342	1	1			
83. 360	2	2			
84. 448	1	1			
85. 482	1	1			
86. 520	1	1			
87. 576	2	2			
88. 640	1	1			
89. 1060	1	1			
90. 1149	1	1			
91. 1228	2	2			
92. 1248	2	2			
93. 1278	2	2			
94. 1280	1	1			
95. 1296	1	1			
96. 1428	1	1			
97. 1458	1	1			
98. 1528	1	1			
99. 1570	1	1			
100. 1720	1	1			
101. 1727	2	2			
102. 1728	372	372			
103. 1729	1	1			
104. 1782	1	1			
105. 1736	1	1			
106. 1738	1	1			
107. 1758	1	1			
108. 1780	1	1			
109. 1786	1	1			
110. 1827	1	1			
111. 1828	1	1			
112. 2000	1	1			
113. 2073	1	1			
114. 2144	1	1			
115. 2278	1	1			
116. 2728	7	7			
117. 2780 (?)	1	1			
118. 2786	1	1			
119. 3024	1	1			
120. 3068	1	1			
121. 3168	1	1			
122. 4500	1	1			
123. 5184	1	1			
124. 6028	1	1			
125. 6912	1	1			
126. 7258	1	1			
127. 7290	2	2			
128. 7528	1	1			
129. 20,736	1	1			
130. 20,776	1	1			
131. 3.31	1	1			
132. 4328	1	1			
133. 1928	1	1			
134. 1721	1	1			
135. Illegible	2			2	
136. No Answer	498				498

respective table, and then these sub-totals reduced to per cents. The treatment given the items of Sections 2 and 3 of the questionnaire was identical with the treatment given the items of Section 1, except for the summary made at the bottom. In summarizing the items of Section 2 it was not possible, in fairness to the various groups, to take one answer as absolutely right. Therefore, it was decided to use a "fair estimate" instead of "right" as the basis for giving credit. Then followed the "wrong", "illegible" and "no answer" returns. For example, notice Exhibit 5 (page 26), showing the answers on the height of a dining-room table. The correct answer is 30 inches, but a fair estimate was taken as running from 28 inches to 34 inches inclusive. Thus the summary under (a) at the bottom, "fair estimate", covers all answers running from 28 inches to 34 in.

Exhibit 6 (page 27) shows the plan of treatment of the items of Section 3. At the left occur the various answers, and at the top the classification of the people returning the questionnaire. At the bottom, however, the summary recognizes one right answer; others are either wrong, illegible or omitted.

It is evident from the questionnaire and from the method of summarizing each item that it was the aim to get answers on a wide range of type of measuring situations and to have the returns come in from people barely capable of answering, up to adults on a university level. In other words, the problem was to get what might be called a map of responses from people on many different levels to many types of situations and

then attempt, when the map had been finally drawn, to give an interpretation in terms of what measures people know and why. As will be developed later, the interpretation will be in terms of answers correct or partly correct, answers wrong, illegible and no answers. The percentages on these items are compiled into tables which will be shown and discussed presently.

2. Item Summaries. A brief summary showing the number of different answers for each item of the questionnaire, together with the most common answers on each item, follows herewith, —

Items Section 1	Total Number of Different Answers	The Most Common Answer
b. gasoline	17	gallon
c. farmland	71	acre
d. milk	33	quart
e. potatoes	39	peck
f. dress goods	67	yard
g. meat	23	pound
h. fish	39	pound
i. apples	45	pound
j. corn	81	dozen
k. wheat	65	bushel
l. cotton lint	52	pound
m. sugar	40	pound
n. eggs	25	dozen
o. oranges	38	dozen
p. lettuce	55	head
q. bread	50	loaf
r. wool	78	pound
s. nails	84	pound
t. wood	122	cord
u. oats	62	bushel

Items Section I	Total Number of Different Answers	The Most Common Answer
b. gasoline	17	gallon
c. farmland	71	acre
d. milk	33	quart
e. potatoes	39	peck
f. dress goods	67	yard
g. meat	23	pound
h. fish	39	pound
i. apples	45	pound
j. corn	81	dozen
k. wheat	65	bushel
l. cotton lint	32	pound
m. sugar	40	pound
n. eggs	25	dozen
o. oranges	38	dozen
p. lettuce	35	head
q. bread	50	loaf
r. wool	78	pound
s. nails	84	pound
t. wood	122	cord
u. oats	62	bushel

Items Section 2	Total Number of Different Answers	The Most Common Answer
a. Height of Dining-room table	169	3 feet
b. Width of Full-sized bed	240	5 feet
c. Height of living room ceiling	196	10 feet
d. Width of side walk in residence section	168	3 feet
e. Width between rails on a railway	182	3 feet

Items Section 3	Total Number of Different Answers	The Most Common Answer
a. Inches in a foot	26	12
b. Ounces in a pound	39	16
c. Inches in a yard	46	36
d. Acres in a quarter section	109	160
e. Quarts in a gallon	24	4
f. Pounds in a bale of cotton	160	500
g. Dozen eggs in a case	90	12
h. Pennyweight in an ounce	72	20
i. Barley corns in an inch	76	4
j. Pounds in a bushel of wheat	95	60
k. Cubic inches in a cubic foot	135	1728

Items Section 2	Total Number of Different Answers	The Most Common Answer
a. Height of dining-room table	169	3 feet
b. Width of full-size bed	280	5 feet
c. Height of living room ceiling	196	10 feet
d. Width of side walk in residence section	168	3 feet
e. Width between rails on a railway	152	3 feet

Items Section 3	Total Number of Different Answers	The Most Common Answer
a. Inches in a foot	20	12
b. Ounces in a pound	39	16
c. Inches in a yard	46	36
d. Acres in a quarter section	109	160
e. Quarts in a gallon	24	4
f. Pounds in a bale of cotton	160	500
g. Dozen eggs in a case	30	12
h. Pennyweight in an ounce	72	20
i. Barley corns in an inch	76	4
j. Pounds in a bushel of wheat	95	60
k. Cubic inches in a cubic foot	135	1728

The summary of each item of the questionnaire reveals an interesting story with many variations, but for the present purpose the attention should be directed to the main points under investigation, namely: What measures do children at different age levels, and adults, know, and what is the explanation of the knowledge?

The main trends with reference to each item, and the chief basis, therefore, for thinking and drawing conclusions, are shown in Tables 1A, 1B, 1C, 1D, 1E, 1F, 1G, 2A, 2B, 2C, 2D, 2E, 3A, 3B, 3C, 3D, and 3E, but before taking up these tables and their interpretation, it will aid in understanding to note some of the more outstanding details with reference to various items in the questionnaire.

The best way to get an idea of the spread of data and the effort at interpretation is to study carefully Exhibits 3, 4, 5 and 6 (pages 24,25,26 and 27), referring respectively to the sale of gasoline, meat and oats, the height of a dining-room table, and the number of cubic inches in a cubic foot.

A brief examination of Exhibit 4, showing the replies to: "In what units are oats sold?", will give a typical picture. The correct answer is bushels. This answer is given by 10% of fourth grade children, and this percentage in general increases with maturity, until it reaches a high level with adults. Among adults however there is considerable variation. A larger proportion of correct answers are given by those from the Middle West where the percentage reaches 93.

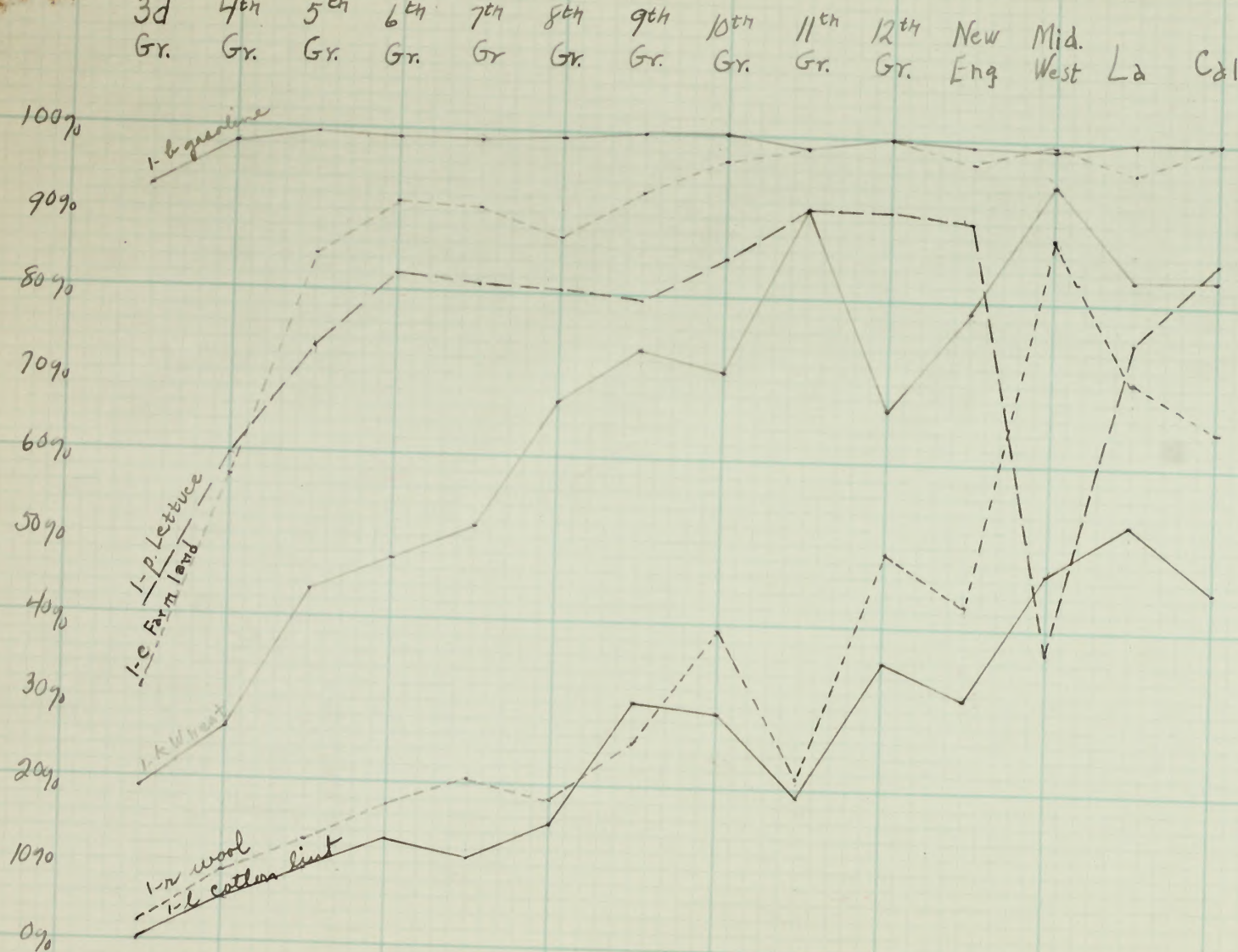
The wrong answers vary widely. Bag is not the correct answer, and yet children in the grades will think of a bag of oats and of course will not know that it is not sold that way. The occurance of bale and barrel is characteristic of answers which are attempted when the facts are not known. The answer box or package is doubtless explained in the lower grade by the buying of a package of rolled oats. The answer pound is of greater frequency than the correct answer bushel in grades three and four. While this is not correct, there is some reason behind it. Oats are weighed by the pound but reduced to bushels. They are bargained for and sold by the bushel, so the correct unit of measure is the bushel.

3. Further typical, illustrative, and special items. Since only a few of the tables are shown (Exhibits 3, 4, 5 and 6, covering units of measure in which gasoline, meat and oats are sold, height of a dining-room table, and the number of cubic inches in a cubic foot), it will be of interest to run over details with reference to some of the other items. But for the present purpose only a few additional items will be discussed in order to give a little fuller notion of the trends and treatment under each*.

---

*The summaries of answers for the various items are given on a per cent basis in Tables 1A, 1B, 1C, 1D, 1E, 1F, 1G, 2A, 2B, 2C, 2D, 2E, 3A, 3B, 3C, 3D, and 3E, beginning on page 44. A brief examination of these tables at this time will aid the reader in the following discussion which immediately follows.

Fig. 1. Showing Graphically the Data on Six Items of Section 1.



In making up summary tables, such as those shown in Exhibits 3, 4, 5 and 6 each different answer was listed, even though one might be reasonably sure that two or more of them meant the same thing. For instance, under 1-g, Meat, a child in the fifth grade answered bls. He probably meant lbs., but that assumption was not made, and bls. was listed as an answer. Under 1-c, farm land, there were many answers similar to acre, such as: ac, acea, acears, aces acra, arc., arca, acer, arces. These were all listed separately. It is quite probable that in some of these cases, the attempt was made to copy from another paper. The answers aker and akre were listed under acre. They would be pronounced acre, and are probably examples of poor spelling. Guart, one of the answers under 1-d, Milk, was translated quart for a fourth grade child. At this age some children may write g for q.

Among the children in the lower grades, as was to be expected, many of the answers are ridiculous. In a good many instances of course the child did not understand the question he was supposed to answer. In some cases the answer had only an associative relation to the item. For instance: fish—gills and sea; eggs—hen; apples—red; corn—garden.

In several cases, —in fact under nearly every item in Section 1, an amount of money is given as an answer; such as: 10¢, 20¢, 5¢, 25¢. Doubtless many of the children are sent to the store for "25 cents worth of hamburg", "20 cents worth of oranges", or "10 cents worth of nails". But, while 15 cents worth may indicate to the youthful buyer the amount wanted, the

fact remains that it is not a unit of measure and that the dealer figures the fraction of a pound or dozen, as the case may be. Whatever the answer, it was listed and included in the summary table for the item.

1-d, Milk. The correct answers on the measures in which milk is sold at retail include bottle, pint, half-pint, liter, and quart. There is an attempt at reasonable generosity here. In every part of the country except New England, the answer gallon figured prominently. This is not likely to be the measure in retail trade. When the gallon is used, no doubt the milk is sold by the farmer to the creamery or to a milk distributor. This brings down the percentage of right answers considerably, particularly in the Middle West. The regular retail method of selling milk throughout the country is by the quart. Therefore, when allowance is made for bottle, pint, half-pint and liter (the common measure in metric Europe) in addition to the quart, it appears that all of the correct retail measures have been included.

1-e, Potatoes. Bushel and peck are the commonest answers here*. In the elementary grades; over 70% gave the answer peck and only about 13% answered bushel. In the junior high school these per centages become 77 and 12; in the senior, 63 and 12. In the adult groups we have in New England about 50% of the answers peck, and about 13% bushel. Among the older people more of the answers combine peck and bushel, and in many cases these are combined with pound and with hundred weight.

---

*The various answers that are accepted as correct are listed in the Appendix for all items of the test. The detail on potatoes is on page 96 .

1-i, Apples. The following figures show on a percentage basis, the distribution of answers among the four most common replies, by the various grade and adult groups. It should be kept in mind that the grade groups in this study are city children of New England.

	pound	bushel	dozen	peck
Elementary grades	40	21	18	12
Jr. High School	62	17	7	5
Sr. High School	65	18	1	6
New England (adults)	40	20	2	10
Middle West (adults)	17	47	0.6	3

(There were many multiple answers from the Middle West, combining especially peck, pound and bushel. 17% answered bushel, pound.)

Louisiana (adults)	1.3	18	62	1.3
California (adults)	50	19	2	0

1-j, Corn. This item also showed interesting variations for different parts of the country. The distribution on a percentage basis among the most common answers in shown here:

	dozen	bushel	pound	ear	peck	can
Elementary grades	24	22	13	10	5	5
Jr. High School	46	21	8	11	2	1
Sr. High School	60	23	4	8	0	0
New England (adults)	54	22	2	10	2	0
Middle West (adults)	4	82	2	0.3	0.3	0
Louisiana (adults)	10	55	3	10	0	0
California (adults)	21	45	5	12	0	0

I-1. Apples. The following figures show on a percentage basis, the distribution of answers among the four most common replies, by the various grade and adult groups. It should be kept in mind that the grade groups in this study are city children of New England.

	pound	bushel	dozen	peck
Elementary grades	40	21	18	12
Jr. High School	62	17	7	5
Sr. High School	65	18	1	6
New England (adults)	40	20	5	10
Middle West (adults)	17	47	0.6	3
Louisiana (adults)	1.3	15	62	1.3
California (adults)	50	19	2	0

(There were many multiple answers from the Middle West, combining especially peck, pound and bushel. 179 answered bushel pound.)

I-1. Corn. This item also showed interesting variations for different parts of the country. The distribution on a percentage basis among the most common answers is shown here:

	dozen	bushel	pound	ear	peck	can
Elementary grades	24	22	13	10	5	5
Jr. High School	46	21	8	11	2	1
Sr. High School	60	23	4	8	0	0
New England (adults)	54	29	2	10	2	0
Middle West (adults)	4	82	2	0.3	0.3	0
Louisiana (adults)	10	55	3	10	0	0
California (adults)	21	46	3	18	0	0

It is clear that in New England children and adults are thinking of green corn for table use, while in the Middle West they are thinking of field corn for feeding stock.

1-k, Wheat. While the two most common answers are pound and bushel, yet the answers bag, bale, box, package, peck, and ton are fairly frequent in the elementary grade, and continue through the high school, even appearing once or twice among adults in New England, but dropping out of the adult answers from the other three sections of the country. The answers package and box doubtless refer to wheat cereals. Here are percentages of the most common answers:

	bushel	pound
Elementary grades	39	19
Jr. High School	62	16
Sr. High School	73	16
New England (adults)	79	6
Middle West (adults)	93	0.6
Louisiana (adults)	83	6
California (adults)	83	5

1-n, Eggs. A majority of even the lower grade children know how eggs are sold, though the answer pound and box appeared a good many times in grades 3 and 4 and persisted even through the seventh grade.

1-o, Oranges. Almost 20% of the children in the elementary grades think that oranges are sold by the pound. Fewer in the junior and senior high school gave this answer. Bushel was next in frequency in the grades.

1-p, Lettuce. In the elementary grades, 13% of the children think lettuce is sold by the pound, 15% of the Junior high school children have the same idea, almost 10% of the Senior High School and, stranger still, in the Middle West this answer had a frequency of practically 50%! Most of these people in the Middle West are from farms or small towns where they neither buy nor sell lettuce, but raise it in their gardens for their own use.

1-r, Wool. The four common answers to this item and their distribution among the various groups on a per cent basis are:

	bale	bushel	pound	yard
Elementary	14	4	12	21
Junior High School	26	3	20	20
Senior High School	22	3	38	18
New England (adults)	23	0	42	6
Middle West (adults)	3	0	88	1
Louisiana (adults)	1	0	70	2
California (adults)	1	0	27	1

1-t, Wood. Among adults, the most numerous answers to this question, beside the correct one, cord, were board foot and foot , evidently confusing wood with lumber. Among elementary grade children, common answers were bag, bushel, feet, load, and ton, the last having a frequency of only one less than cord. In each of the three lowest grades ton had the greatest frequency.

Thus we begin to get a notion of the knowledge of measures at the various grade levels and in different sections of the country.

Exhibit 5, page 26 shows a summary of the answers to Item 2-a of the questionnaire, the height of a dining-room table. This exhibit showing the tabled facts, gives a good idea of the failure of our usual teaching of measures to build up adequate concepts on a basis for estimating or thinking. The people answering the questionnaire sit at a dining-room table three times a day. This constant contact however does not prevent such ridiculous answers as $2\frac{1}{2}$ inches at one extremity (an answer given by a junior high school pupil) or 15 yards near the opposite extreme (an answer given by a twelfth grade pupil). Adults give answers running up to thirty and thirty-five feet. Even the 36 inches or 3 feet answer is not creditable, and yet that was the most common answer. Anyone who is at all able to estimate should not estimate a table height as 3 feet, certainly not 4 feet, another very common answer.

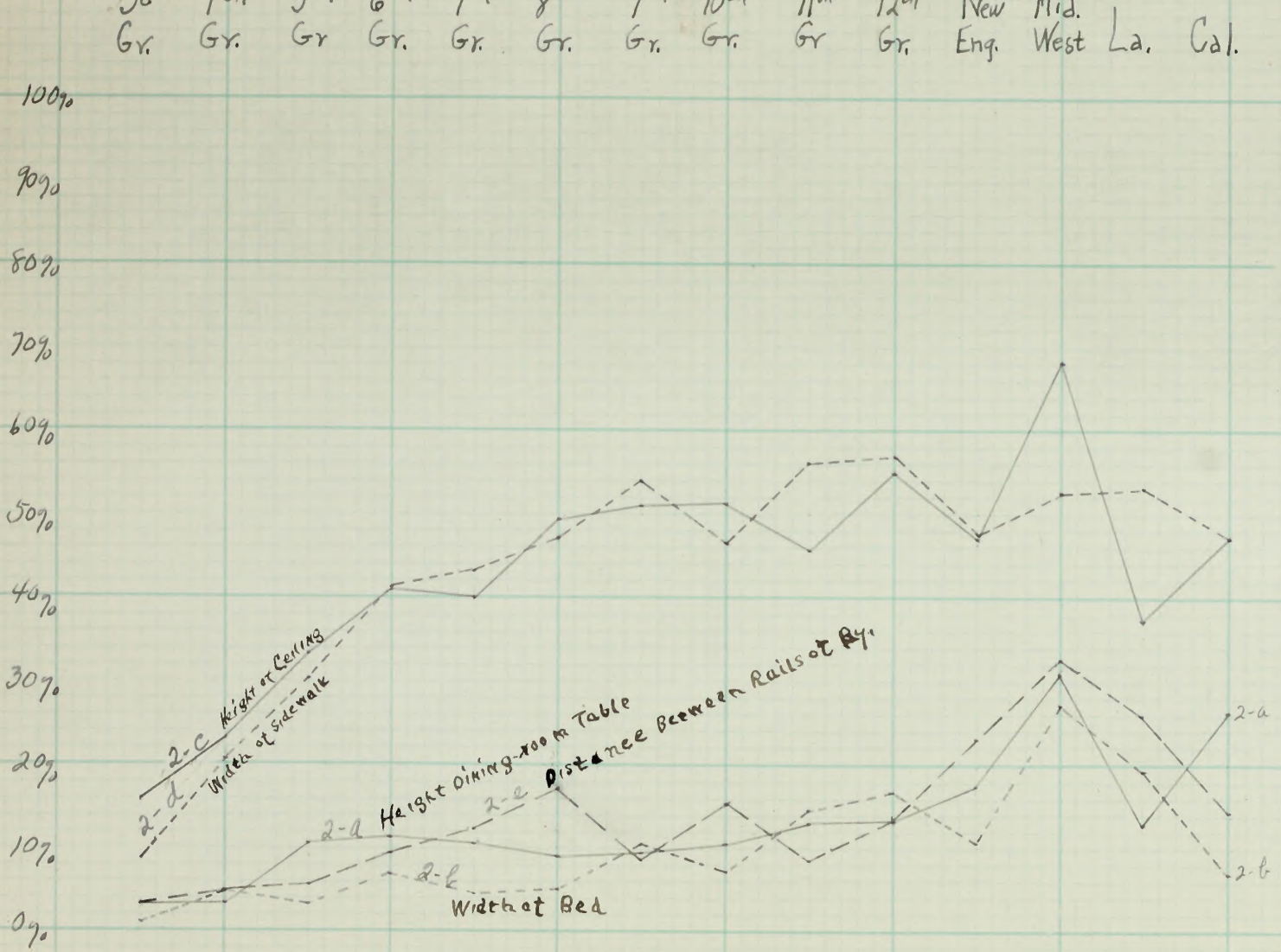
Under Item 2-b, the width of a full-sized bed, the answers run from 2 inches (from a child in the fourth grade) to 492 feet (from a third grade child). There is one answer among adults as low as 10 inches. Other adult answers are 16 feet and 18 feet. They may have meant inches, but that would be almost as discreditable.

Item 2-c, the height of a ceiling, has so many answers that are less than 2 feet that we must assume that those answering had in mind something other than the distance from floor to ceiling. The answers 10 inches and 12 inches are given by adults. (They may have meant feet.) The answer 6 feet was given by 10 adults, and 7 feet by 13 adults. Fifty-five per cent of the adults gave an answer to this question which might be considered a fair estimate.

The answers to 2-d, the width of a sidewalk in a residence section, cluster about 3 feet, 3½ feet, 4 feet, 5 feet, and 6 feet. There were 3 adults who gave the answer 2 feet; 7 who say 2½ feet; 141 who say 3 feet; 172 who say 4 feet; and 351, which is 50.8%, of the adults give an acceptable answer.

Item 2-e, the distance between the rails of a railroad, has as correct answer 4 ft., 8½ in., which only 4 people knew, all adults, —2 in New England and 2 in Indiana. Among the adults, the answers having greatest frequency were 4 feet, 19.8%; 5 feet, 9.5%; 6 feet, 9.1%. The total range among adults was from 1 foot to 15 feet. Most of the answers ranged between 2 feet and 6 feet, 26 of the adults giving the latter answer.

Fig. 2. Showing Graphically the Data on Five Items of Section 2.



Section 3 of the questionnaire gives an opportunity for answers on eleven isolated measuring or denominate number facts. The simpler ones, such as the number of inches in a foot, or the number of quarts in a gallon are answered correctly by a large number of people at all levels of maturity. And yet a surprising number think there are 8 quarts in a gallon, even among adults. Among the many different answers given to 3-g, the number of dozens of eggs in a crate, there is a tendency to cluster around 12, 24, 36 and 144, although the correct answer, 30, is the second most common. Among the children almost no one knows the answer to this item. The percentage of frequency of the correct answer among adults is 17.7. But this would be much lower if it were not for the Middle West, where the percentage of right answers is 26.5. Eggs are produced, packed and shipped from this region in large quantities.

Common answers to 3-h, the number of pennyweights in an ounce, are 2, 3, 4, 10, 12, and 16, and among adults the answer 12 is given by 49 people, while the correct answer, 20, has a frequency of 51.

The answers to 4-i, the number of barleycorns in an inch, are, for the most part of course, mere guesses. The guesses come mostly from the children, whose school training doubtless leads them to believe that the wrong answer carries more credit than no answer. The answer 4 has by far the greatest frequency, 2 next and then 5, 6 and then 3, which is the correct answer.

The one of these eleven items which is shown in full, Exhibit 6, page 27, is the number of cubic inches in a cubic foot. The answers here even at the Junior High School level, range from 1 through 1928. The percentage of correct answers increases constantly with maturity. There is no sudden increase in correctness. This is a fact taught in the intermediate grades of practically all schools. Yet, the answers cluster about 12 and 144, as well as around the correct answer, 1728, showing, as one might expect, a confusion of linear, square and cubic measure. The answer 12 was most common in the elementary grades, where its frequency constituted almost 10% of the total number. But, more surprising still, almost 6% of the Junior High School children gave this answer, more than 9% of the Senior High School people, and almost 2½% of the adults. The number 144 was given by only 3½% of the elementary grade children, over 15% of those in the Junior High School, 17½% of those in the Senior High School, and almost 12½% of the adults.

4. Resulting Tables and Comparisons. Each of the thirty-six items of Sections 1, 2 and 3 of the original questionnaire was tabled in a form similar to those shown in Exhibits 3, 4, 5 and 6. Each table had a summary at the bottom showing the number of answers right, wrong, etc., as previously explained. With the summary thus far advanced, it was an easy matter to draw off Tables 1A, 1B, 1C, 1D, 1E,

1F and 1G, in order to bring together in summary form the percentages of rights, wrongs, etc., for the twenty items of Section 1.

In a similar way, Tables 2A, 2B, 2C, 2D, and 2E were drawn off as a summary of the items of Section 2, and in in like manner Tables 3A, 3B, 3C, 3D, and 3E summarize the eleven items of Section 3.

Table 1A. Showing the Percentage of right answers to the twenty items (b to u) of Section 1 of the Questionnaire

	3rd Grade	4th Grade	5th Grade	6th Grade	Grade Total	7th Grade	8th Grade	9th Grade	Jr. H.S. Total
1-b Gasoline	92.6	98.1	99.7	99.1	98.4	98.8	99.6	100.0	99.4
1-c Farm land	30.9	57.6	84.2	91.5	76.2	90.5	87.1	92.9	89.6
1-d Milk	91.5	91.8	99.4	98.8	96.7	97.8	98.8	99.2	98.3
1-e Potatoes	83.0	92.6	96.9	97.4	94.9	99.6	98.4	100.0	99.2
1-f Dress goods	46.8	75,5	83.5	89.6	80.8	87.9	91.3	88.9	89.5
1-g Meat	79.8	90.3	96.3	98.3	94.3	99.2	99.6	100.0	99.5
1-h Fish	62.8	77.4	89.4	93.6	85.9	97.0	96.1	96.8	96.6
1-i Apples	89.4	93.4	96.8	99.1	96.2	98.9	99.6	99.2	99.2
1-j Corn	30.9	50.6	67.4	73.5	62.7	80.8	85.2	85.7	83.5
1-k Wheat	19.1	26.1	43.8	47.8	39.1	53.6	66.8	73.8	62.8
1-l Cotton lint	0.0	5.5	9.6	13.2	9.2	10.9	15.6	30.1	16.5
1-m Sugar	84.0	91.1	97.8	99.1	95.5	98.5	98.4	96.8	96.6
1-n Eggs	67.0	82.4	93.8	98.3	90.6	97.4	97.7	99.2	97.7
1-o Oranges	40.4	63.8	73.9	88.1	74.1	93.2	92.6	95.2	93.3
1-p Lettuce	40.4	59.5	72.9	82.0	70.5	80.4	80.1	79.4	80.1
1-q Bread	69.1	78.2	87.3	86.5	83.5	89.1	87.1	96.0	89.6
1-r Wool	2.1	8.6	12.7	17.7	12.8	20.7	18.4	25.4	20.7
1-s Nails	13.8	31.5	441.	50.4	41.0	57.0	59.8	73.0	61.2
1-t Wood	2.1	10.9	27.3	35.9	24.6	43.8	50.8	79.4	53.5
1-u Oats	10.6	14.0	25.8	28.8	22.9	38.1	48.4	57.1	46.2

(This table is completed on the following page.)

(Page 3 of 4 pages)

This table is completed on the following page.

Operation	Write	Read	Status	Command	Data	Control	Status
	Address	Address	Input	Output	Output	Output	Input
	0	1	2	3	4	5	6
Select drive 0							
Select drive 1							
Select drive 2							
Select drive 3							
Select head 0							
Select head 1							
Select head 2							
Select head 3							
Select head 4							
Select head 5							
Select head 6							
Select head 7							
Select head 8							
Select head 9							
Select head 10							
Select head 11							
Select head 12							
Select head 13							
Select head 14							
Select head 15							
Select sector 0							
Select sector 1							
Select sector 2							
Select sector 3							
Select sector 4							
Select sector 5							
Select sector 6							
Select sector 7							
Select sector 8							
Select sector 9							
Select sector 10							
Select sector 11							
Select sector 12							
Select sector 13							
Select sector 14							
Select sector 15							
Select sector 16							
Select sector 17							
Select sector 18							
Select sector 19							
Select sector 20							
Select sector 21							
Select sector 22							
Select sector 23							
Select sector 24							
Select sector 25							
Select sector 26							
Select sector 27							
Select sector 28							
Select sector 29							
Select sector 30							
Select sector 31							
Select stage 0							
Select stage 1							
Select stage 2							
Select stage 3							
Select stage 4							
Select stage 5							
Select stage 6							
Select stage 7							
Select stage 8							
Select stage 9							
Select stage 10							
Select stage 11							
Select stage 12							
Select stage 13							
Select stage 14							
Select stage 15							
Select stage 16							
Select stage 17							
Select stage 18							
Select stage 19							
Select stage 20							
Select stage 21							
Select stage 22							
Select stage 23							
Select stage 24							
Select stage 25							
Select stage 26							
Select stage 27							
Select stage 28							
Select stage 29							
Select stage 30							
Select stage 31							
Total stage							
Select head 16							
Select head 17							
Select head 18							
Select head 19							
Select head 20							
Select head 21							
Select head 22							
Select head 23							
Select head 24							
Select head 25							
Select head 26							
Select head 27							
Select head 28							
Select head 29							
Select head 30							
Select head 31							
Total S.H. 16							
Select stage 32							
Select stage 33							
Select stage 34							
Select stage 35							
Select stage 36							
Select stage 37							
Select stage 38							
Select stage 39							
Select stage 40							
Select stage 41							
Select stage 42							
Select stage 43							
Select stage 44							
Select stage 45							
Select stage 46							
Select stage 47							
Select stage 48							
Select stage 49							
Select stage 50							
Select stage 51							
Select stage 52							
Select stage 53							
Select stage 54							
Select stage 55							
Select stage 56							
Select stage 57							
Select stage 58							
Select stage 59							
Select stage 60							
Select stage 61							
Select stage 62							
Select stage 63							
Total stage							

(Page 4 of 4 pages) Items 0 to 63 are described in section 4.4.1.

Table 1A. Showing the Percentage of right answers to the twenty items (b to u) of Section 1 of the Questionnaire

	10th Grade	11th Grade	12th Grade	Sr. H.S. Total	N. E. Adults	Mid-West Ad.	La. Adults	Cal. Adults	Adult Total
1-b Gasoline	100.0	98.4	100.0	99.7	99.6	99.1	100.0	100.0	99.4
1-c Farm land	96.9	98.4	100.0	98.1	97.7	99.4	96.1	100.0	98.4
1-d Milk	96.4	100.0	92.1	95.9	94.6	77.1	59.7	83.3	81.6
1-e Potatoes	98.8	100.0	100.0	99.4	97.9	97.6	92.2	97.6	97.1
1-f Dress goods	93.9	91.8	97.8	97.8	98.8	99.4	97.4	100.0	99.0
1-g Meat	99.4	98.4	100.0	99.4	99.2	99.7	98.7	97.6	99.3
1-h Fish	98.8	96.7	100.0	98.7	98.8	98.8	97.4	95.3	98.4
1-i Apples	100.0	100.0	100.0	100.0	99.6	99.4	98.7	95.2	99.1
1-j Corn	94.5	98.4	89.9	93.9	89.6	93.1	83.1	88.1	90.4
1-k Wheat	70.7	91.8	66.3	73.6	79.0	94.3	83.1	83.3	86.3
1-l Cotton lint	29.3	19.7	36.0	29.0	31.9	47.0	53.2	45.2	41.4
1-m Sugar	96.3	100.0	97.8	97.5	99.6	97.9	93.5	95.2	97.8
1-n Eggs	99.4	100.0	100.0	99.7	98.7	98.2	94.8	100.0	98.2
1-o Oranges	97.6	98.4	95.5	97.1	95.0	87.3	87.0	95.2	90.4
1-p Lettuce	84.8	91.8	91.0	87.9	90.0	38.3	75.3	85.7	63.4
1-q Bread	85.4	96.7	91.1	89.2	91.7	88.2	84.4	95.3	89.4
1-r Wool	39.6	21.3	49.4	38.9	42.6	88.0	70.1	64.3	66.4
1-s Nails	70.7	77.0	82.0	75.2	83.2	92.5	89.6	83.3	87.9
1-t Wood	80.5	91.8	78.7	82.2	66.1	75.6	68.8	64.3	70.4
1-u Oats	64.6	90.2	64.0	69.6	69.2	93.4	70.1	81.0	81.6

(This table is continued from the preceding page.)

Table 1B. Showing the Percentage of answers, part wrong, and part right to the twenty Items (b to u) of Section 1 of the Questionnaire, separated as to grades, and different parts of the Country.

	3rd Grade	4th Grade	5th Grade	6th Grade	Grade Total	7th Grade	8th Grade	9th Grade	Jr. H.S. To.	10th Grade	11th Grade	12th Grade	Sr. H.S. To.	N.E. Adults	Mid-West Ad.	La. Adults	Cal. Adults	Adult Total
1-b Gasoline	0.0	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-c Farm land	0.0	0.0	1.0	0.0	0.2	1.1	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.6	0.3	0.0	0.0	0.4
1-d Milk	0.0	0.4	0.0	0.9	0.5	1.4	0.0	0.8	0.9	3.6	0.0	4.5	3.1	5.4	15.1	22.1	11.9	12.3
1-e Potatoes	0.0	0.0	1.3	0.5	0.6	0.0	0.4	0.0	0.2	0.6	0.0	0.0	0.3	1.3	2.1	2.6	0.0	1.7
1-f Dress goods	0.0	0.0	0.3	0.5	0.3	0.8	0.4	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.1
1-g Meat	0.0	0.4	0.0	0.0	0.1	0.4	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.3
1-h Fish	0.0	0.0	0.3	0.0	0.1	0.0	0.4	0.0	0.2	0.6	0.0	0.0	0.3	1.2	0.3	0.0	0.0	0.6
1-i Apples	0.0	0.4	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.1
1-j Corn	0.0	0.4	0.0	0.2	0.2	0.4	0.4	0.8	0.5	0.6	0.0	0.0	0.3	2.9	3.9	7.8	4.8	4.1
1-k Wheat	0.0	0.4	0.0	0.0	0.1	1.1	0.0	1.6	0.8	1.3	0.0	1.1	1.0	1.0	3.9	5.2	2.4	2.7
1-l Cotton lint	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.2	0.0	0.0	1.1	0.3	1.0	0.3	1.3	0.0	0.7
1-m Sugar	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.8	0.5	0.0	0.0	0.0	0.0	0.0	0.3	2.6	0.0	0.4
1-n Eggs	0.0	0.4	0.0	0.2	0.2	0.4	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.6	1.5	3.9	0.0	1.3
1-o Oranges	0.0	0.0	0.0	0.5	0.2	0.4	0.4	0.8	0.5	1.2	0.0	2.2	1.3	3.8	11.4	7.8	2.4	7.8
1-p Lettuce	0.0	0.0	0.3	0.2	0.2	1.1	2.3	3.2	2.0	2.4	0.0	1.1	1.6	4.6	10.5	6.5	2.4	7.5
1-q Bread	0.0	0.0	0.3	0.0	0.1	0.8	0.4	0.8	0.6	0.6	0.0	0.0	0.3	2.1	1 .8	1.3	2.4	1.9
1-r Wool	0.0	0.0	0.3	0.2	0.2	0.4	0.0	0.0	0.2	0.6	0.0	1.1	0.6	3.2	0.3	3.9	7.1	2.2
1-s Nails	0.0	0.4	0.6	0.5	0.5	0.4	0.4	1.6	0.6	1.8	0.0	2.2	1.6	3.2	1.5	0.0	2.4	2.1
1-t Wood	0.0	0.0	0.0	0.7	0.3	4.2	0.4	4.0	2.6	4.9	0.0	1.1	2.9	7.4	7.8	3.9	9.5	7.4
1-u Oats	0.0	0.0	0.6	0.5	0.4	1.0	0.4	4.8	1.5	4.3	0.0	2.2	2.8	3.8	4.2	2.6	2.4	3.8

Table 1C. Showing the Percentage of Wrong answers to the twenty Items (b to u) of Section 1 of the Questionnaire

	3rd Grade	4th Grade	5th Grade	6th Grade	Grade Total	7th Grade	8th Grade	9th Grade	Jr. H.S. To.	10th Grade	11th Grade	12th Grade	Sr. H.S. To.
1-b Gasoline	2.1	1.6	0.0	0.7	0.8	1.1	0.4	0.0	0.6	0.0	0.0	0.0	0.0
1-c Farm land	30.9	23.0	9.9	6.8	13.6	7.5	10.5	7.1	8.7	2.4	0.0	0.0	1.3
1-d Milk	4.3	2.7	0.6	0.2	1.3	0.4	1.2	0.0	0.6	0.0	0.0	3.4	1.0
1-e Potatoes	8.5	2.7	1.6	2.1	2.6	0.4	1.2	0.0	0.6	0.6	0.0	0.0	0.3
1-f Dress goods	16.0	8.2	11.5	5.7	8.8	6.8	7.0	10.3	7.6	5.5	4.9	2.2	4.4
1-g Meat	5.3	3.9	0.9	0.7	1.9	0.4	0.4	0.0	0.3	0.0	0.0	0.0	0.0
1-h Fish	10.6	5.1	2.5	2.6	3.8	1.1	2.3	2.4	1.8	0.6	1.6	0.0	0.6
1-i Apples	1. 1	1.6	0.6	0.4	0.8	0.4	0.4	0.0	0.3	0.0	0.0	0.0	0.0
1-j Corn	41.5	30.4	24.5	19.9	25.5	14.7	11.7	11.9	13.0	4.3	1.6	10.1	5.4
1-k Wheat	41.5	35.8	40.1	37.8	38.2	30.6	27.3	20.6	27.3	25.0	6.6	31.5	23.2
1-l Cotton lint	35.1	39.3	49.7	50.5	46.3	49.4	50.8	44.4	49.0	50.0	49.2	44.9	48.4
1-m Sugar	1.1	1.6	0.0	0.7	0.8	0.0	1.6	1.6	0.9	3.7	0.0	2.2	2.5
1-n Eggs	19.1	12.5	5.0	1.4	6.6	2.3	2.3	0.0	1.9	0.6	0.0	0.0	0.3
1-o Oranges	42.5	30.3	23.3	10.4	21.6	6.0	6.3	3.2	5.6	1.2	1.6	2.2	1.6
1-p Lettuce	23.6	22.9	20.2	14.9	19.1	18.1	17.2	16.7	17.5	12.2	6.6	7.9	9.9
1-q Bread	9.6	10.5	9.6	9.0	9.6	9.8	11.7	2.4	9.1	13.4	1.6	9.0	9.9
1-r Wool	44.7	51.0	57.2	56.5	54.4	61.5	59.8	58.7	60.3	50.6	60.7	43.8	50.6
1-s Nails	41.5	34.6	35.1	33.3	34.9	29.4	28.5	20.6	27.4	22.6	18.0	15.7	19.7
1-t Wood	46.8	54.1	50.6	45.6	49.2	37.0	43.0	15.9	35.2	13.4	8.2	20.2	14.3
1-u Oats	50.0	53,7	54.6	54.4	53.9	46.0	39.5	31.0	40.5	28.7	6.6	31.5	25.1

(This table is completed on the following page.)

Table 1C. Showing the Percentage of Wrong answers to the twenty Items (b to u) of Section 1 of the Questionnaire

	N. E. Adults	Mid-West Ad.	La. Adults	Cal. Adults	Adults Total
1-b Gasoline	0.4	0.6	0.0	0.0	0.4
1-c Farm land	1.0	0.0	0.0	0.0	0.4
1-d Milk	0.0	7.5	16.9	4.8	5.8
1-e Potatoes	0.8	0.0	2.6	2.4	0.7
1-f Dress goods	0.4	0.0	1.3	0.0	0.3
1-g Meat	0.0	0.0	0.0	2.4	0.1
1-h Fish	0.0	0.3	1.3	2.3	0.4
1-I Apples	0.0	0.0	0.0	4.8	0.3
1-j Corn	4.6	2.7	5.2	7.1	3.9
1-k Wheat	13.2	1.5	7.8	14.3	7.6
1-l Cotton lint	43.9	24.1	26.0	14.3	31.8
1-m Sugar	0.4	1.2	1.3	2.4	1.0
1-n Eggs	0.6	0.0	0.0	0.0	0.3
1-o Oranges	1.3	0.9	2.6	2.4	1.3
1-p Lettuce	5.4	50.3	15.6	9.5	28.4
1-q Bread	6.2	9.3	11.7	2.4	8.1
1-r Wool	40.0	7.8	18.2	14.3	22.3
1-s Nails	10.0	3.9	3.9	4.8	6.4
1-t Wood	24.8	15.1	20.8	21.4	20.0
1-u Oats	23.3	1.5	24.7	14.3	12.4

(This table is continued from the preceding page.)

Table 1D. Showing the Percentage of Illegible answers to the twenty Items (b to u) of Section 1 of the Questionnaire separated as to Grades and Different Parts of the Country.

	3rd Grade	4th Grade	5th Grade	6th Grade	Grade Total	7th Grade	8th Grade	9th Grade	Jr. H.S. To.	10th Grade	11th Grade	12th Grade	Sr. H.S. To.	N. E. Adults	Mid-West Ad.	La. Adults	Cal. Adults	Adult Total
1-b Gasoline	3.2	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.1
1-c Farm land	2.1	1.9	0.6	0.0	0.6	0.0	0.4	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.1
1-d Milk	2.1	3.9	0.0	0.0	1.1	0.4	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.1
1-e Potatoes	2.1	2.3	0.3	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.3	0.0	0.3
1-f Dress goods	2.1	2.7	0.0	0.5	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.1
1-g Meat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.1
1-h Fish	0.0	0.8	0.3	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.1
1-i Apples	2.1	1.9	0.9	0.0	0.9	0.4	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.1
1-j Corn	1.1	1.6	1.2	0.5	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.3	2.6	0.0	0.6
1-k Wheat	1.1	3.1	0.9	0.0	1.1	1.1	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.1
1-l Cotton lint	2.1	1.9	0.6	0.2	0.9	0.4	0.0	0.0	0.2	0.0	1.6	0.0	0.3	0.0	0.3	0.0	0.0	0.1
1-m Sugar	2.1	1.6	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.3	0.0	0.3
1-n Eggs	2.1	1.5	0.6	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.1
1-o Oranges	2.1	1.9	0.3	0.0	0.7	0.0	0.4	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.1
1-p Lettuce	3.2	1.6	0.3	0.0	0.7	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.3	0.0	0.3	0.0	0.0	0.1
1-q Bread	2.1	3.1	0.3	0.0	1.0	0.0	0.4	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.3
1-r Wool	4.2	2.3	0.0	0.5	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.0	0.0	0.3
1-s Nails	2.1	3.1	0.6	0.0	1.1	0.4	0.0	0.8	0.3	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.3
1-t Wood	1.1	2.7	0.0	0.0	0.7	1.1	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.3	1.3	0.0	0.3
1-u Oats	2.1	1.1	0.6	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.1

Table 1E. Showing the Percentage of "No Answers" to the twenty Items (b to u) Section 1 of the Questionnaire

	3rd Grade	4th Grade	5th Grade	6th Grade	Grade Total	7th Grade	8th Grade	9th Grade	Jr. H.S. To.	10th Grade	11th Grade	12th Grade	Sr. H.S. To
1-b Gasoline	2.1	0.3	0.3	0.2	0.5	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.3
1-c Farm land	36.2	17.5	4.3	1.7	9.1	0.8	2.0	0.0	1.1	0.6	1.6	0.0	0.6
1-d Milk	2.1	1.2	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-e Potatoes	6.3	2.3	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-f Dress goods	3.5	13.6	4.7	3.8	9.0	4.5	1.2	0.8	2.5	0.6	3.3	0.0	1.0
1-g Meat	14.9	5.4	2.8	0.9	3.7	0.0	0.0	0.0	0.0	0.6	1.6	0.0	0.6
1-h Fish	26.6	16.7	7.5	3.8	9.9	1.9	1.2	0.8	1.4	0.0	1.6	0.0	0.3
1-i Apples	7.4	2.7	1.8	0.4	2.0	0.4	0.0	0.8	0.3	0.0	0.0	0.0	0.0
1-j Corn	26.6	17.1	6.8	5.9	10.6	4.2	2.7	1.6	3.1	0.6	0.0	0.0	0.3
1-k Wheat	38.4	34.6	15.2	14.4	21.4	13.5	5.9	4.0	8.7	3.1	1.6	1.1	2.2
1-l Cotton lint	62.8	53.3	40.1	36.1	43.6	38.9	33.6	25.4	34.2	20.7	29.5	18.0	21.7
1-m Sugar	12.8	5.8	2.2	0.2	3.1	0.8	0.0	0.8	0.5	0.0	0.0	0.0	0.0
1-n Eggs	11.7	3.1	0.6	0.0	1.9	0.0	0.0	0.8	0.2	0.0	0.0	0.0	0.0
1-o Oranges	14.9	3.9	2.5	0.9	3.3	0.4	0.4	0.8	0.5	0.0	0.0	0.0	0.0
1-p Lettuce	32.9	15.9	6.2	2.8	9.5	0.4	0.4	0.8	0.5	0.0	1.6	0.0	0.3
1-q Bread	19.1	7.4	2.5	4.7	5.9	0.4	0.4	0.8	0.4	0.6	1.6	0.0	0.6
1-r Wool	48.9	38.1	29.8	25.1	31.6	17.4	21.9	15.9	18.9	9.1	18.0	5.6	9.9
1-s Nails	42.6	30.4	19.6	15.8	22.6	12.8	11.3	4.0	10.5	4.9	4.9	0.0	3.5
1-t Wood	50.0	32.3	22.0	17.7	25.2	14.0	5.9	0.8	8.2	1.2	0.0	0.0	0.6
1-u Oats	37.2	31.1	18.3	16.3	22.2	14.8	11.7	5.6	11.7	2.4	3.2	2.2	2.5

(This table is completed on the following page.)

Table 1E. Showing the Percentage of "No Answers to the twenty Items (b to u) of Section 1 of the Questionnaire

	N. E. Adults	Mid-West Ad.	La. Adults	Cal. Adults	Adults Total
1-b Gasoline	0.0	0.0	0.0	0.0	0.0
1-c Farm land	0.6	0.3	2.6	0.0	0.7
1-d Milk	0.0	0.0	1.3	0.0	0.1
1-e Potatoes	0.0	0.0	1.3	0.0	0.1
1-f Dress goods	0.8	0.0	1.3	0.0	0.4
1-g Meat	0.0	0.0	1.3	0.0	0.1
1-h Fish	0.0	0.3	1.3	2.3	0.4
1-i Apples	0.0	0.3	1.3	0.0	0.3
1-j Corn	2.5	0.0	1.3	0.0	1.0
1-k Wheat	6.8	0.0	3.9	0.0	3.2
1-l Cotton lint	23.2	28.3	19.5	40.5	26.0
1-m Sugar	0.0	0.3	1.3	2.4	0.4
1-n Eggs	0.0	0.0	1.3	0.0	0.1
1-o Oranges	0.0	0.0	2.6	0.0	0.3
1-p Lettuce	0.0	0.6	2.6	2.4	0.7
1-q Bread	0.0	0.0	2.6	0.0	0.3
1-r Wool	13.9	3.6	7.8	14.3	8.8
1-s Nails	3.5	1.5	6.5	9.5	3.3
1-t Wood	1.6	1.2	5.2	4.8	2.0
1-u Oats	3.8	0.6	2.6	2.4	2.0

(This table is continued from the preceding page.)

It will be apparent from Table 1A that even the children in the third grade have learned something about measures from commodities commonly used by the family. Their right answers on gasoline, milk, apples, sugar, potatoes and meat show noticeably high frequency. In general the number of right answers to these items increases with each higher grade.

The correct answers to 1-c, farm land, 76.2%, and 1-f, dress goods, 80.8%, are higher in the elementary grades, than might be expected from the small experience these children have had with farm land and dress-goods. It is quite likely that conversation at home and written problems at school have supplied this information. There may be some other explanation. With cotton lint, wool, and wood the lack of information is evident.

Among the adults the percentage of right answers is very high on the more common measures. Under 1-d, Milk, the percentage of right answers is brought down in the Middle West and Louisiana by the number who mention the gallon. These people in large numbers are not accustomed to buy or sell milk at retail. They live on farms and produce their own milk.

No one even among the adults is very sure how cotton lint is sold. Louisiana, in the cotton belt, might have been expected to score well. But she spoiled her record by the large number of answers bale. Cotton lint is packed and handled in bales, but sold at so much per pound, exactly as you buy a bag of sugar but pay so much per pound for it. The pound is the measure.

Referring to Table 1A further, we see that in the case of Item 1-p, lettuce, the percentage of correct answers among New England adults is 90.0; in the Middle West, 38.3; in Louisiana, 75.3 and in California 85.7. These Middle Westerners are largely from rural sections and people on farms in this part of the country do not buy or sell lettuce.

New Englanders, at least those living near Boston, have little to do with buying or selling wool, except those engaged in special lines. Many in the Middle West raise sheep. The percentages of correct answers on this item are: New England, 42.6; Middle West, 88.0.

The difference between these sections on the item 1-u, oats, is noticeable also. In the Middle West, where oats are raised, we have 93.4% of the answers correct. In the New England section where oats are little known only 69.2% of the answers of adults are correct.

Tables 1B, 1C, 1D, and 1E. Table 1B results from answers on an item that are partly right and partly wrong. Such answers are always multiple answers. The summary of 1-u, Oats, shown in Exhibit 3, page 24 , may be used as an illustration. The fourth answer is bag, bushel. Bushel is correct; bag is wrong. While oats are handled in a bag and may even be occasionally priced that way for special trade, in general oats are priced and sold only by the bushel. Answer 14, under the same item is another illustration. There we have the answer barrel,

bushel. Barrel is wrong; bushel is correct. A total of three children running up through the Senior High School gave this double answer. There are comparatively few multiple answers in the elementary grades. The number increases in the High School and adult groups.

The comparison of Tables 1A and 1B on Item 1-d, Milk, makes very clear the close relationship between the various tables covering Section 1 of the questionnaire, namely Tables 1A, 1B, 1C, 1D and 1E. Where the percentages in Table 1A fall below 100, the difference must be made up by the percentages in Tables 1B, 1C, 1D and 1E. The percentage variation in each of these tables changes from item to item. While on the item 1-d, Milk, most of the failure to reach 100% in Table 1A is explained by the heavy percents shown in Table 1B, on the other hand, the difference between 100% and the percentage right on Item 1-l, Cotton lint, is largely taken up in Table 1C, "Wrong answers". On a number of other items the wrong answer element, as developed in Table 1C, is very significant, —for instance, on Items 1-j, Corn, and 1-k, Wheat, with elementary children in Boston and the Eastern Massachusetts area.

Some items clear up rapidly. For instance, Item 1-o, Oranges, shows in Table 1C, 42.5% of the third grade children giving a wrong answer. This reduces to 23.3% in the fifth grade and falls very rapidly to an average of 1.6% in the Senior High School.

As a rule Table 1C, giving percentages of wrong

Table 1F. Showing the percentage of answers which are not a unit of measure to the twenty Items of Section 1 of the Questionnaire, separated as to Grades and different parts of the Country.

	3rd Grade	4th Grade	5th Grade	6th Grade	Grade Total	7th Grade	8th Grade	9th Grade	Jr. H.S. To.	10th Grade	11th Grade	12th Grade	Sr. H.S. To.	N.E. Adults	Mid-West ad.	La. Adults	Cal. Adults	Adult Total
1-b Gasoline	2.1	1.6	0.0	0.5	0.7	1.1	0.4	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.1
1-c Farm land	7.4	4.7	3.7	0.7	3.1	5.3	5.5	1.6	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-d Milk	0.0	1.2	0.0	0.2	0.5	0.0	0.4	0.0	0.2	0.0	0.0	3.4	1.0	0.0	0.3	0.0	2.4	0.2
1-e Potatoes	0.0	0.8	0.3	0.2	0.4	0.0	0.4	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.1
1-f Dress Goods	5.3	3.9	7.8	2.6	4.6	3.8	3.1	5.5	3.9	3.1	0.0	2.2	2.2	0.0	0.0	1.3	0.0	0.1
1-g Meat	1.1	1.9	0.3	0.2	0.7	0.4	0.4	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.1
1-h Fish	2.1	2.4	0.6	0.7	1.2	0.4	0.8	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	1.3	2.3	0.3
1-i Apples	0.0	1.1	0.0	0.2	0.4	0.4	0.4	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.1
1-j Corn	1.1	1.2	0.9	1.4	1.2	0.4	1.2	0.0	0.6	0.0	1.6	0.0	0.3	0.0	0.0	0.0	0.0	0.0
1-k Wheat	4.2	1.6	1.6	2.6	2.2	2.6	0.1	0.0	1.4	1.8	0.0	1.1	0.1	0.0	0.3	0.0	2.4	0.3
1-l Cotton lint	0.0	1.2	0.9	0.5	0.7	0.8	0.4	1.6	0.8	0.0	0.0	0.0	0.0	0.0	0.3	0.0	2.4	0.3
1-m Sugar	0.0	0.4	0.0	0.5	0.3	0.0	0.4	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.1
1-n Eggs	0.0	0.8	0.0	0.2	0.3	0.0	0.4	0.0	0.2	0.6	0.0	0.0	0.3	0.6	0.0	0.0	0.0	0.3
1-o Oranges	0.0	0.8	0.3	0.2	0.4	0.0	0.4	0.8	0.3	0.6	0.0	0.0	0.3	0.8	0.0	0.0	0.0	0.3
1-p Lettuce	1.1	0.8	0.0	0.2	0.4	0.0	0.4	0.0	0.2	0.0	0.0	1.1	0.3	0.0	0.3	0.0	0.0	0.1
1-q Bread	1.1	1.6	1.2	1.4	1.4	2.3	1.2	0.0	1.4	1.8	0.0	1.1	1.3	1.3	0.0	2.6	2.4	0.9
1-r Wool	0.0	3.9	3.7	1.7	2.6	2.2	1.2	0.8	1.5	1.8	1.6	1.1	1.5	1.3	1.5	0.0	2.4	1.3
1-s Nails	2.1	2.3	0.9	1.2	1.5	1.5	2.0	2.4	1.9	3.7	1.6	0.0	2.2	2.6	0.9	1.3	2.4	0.9
1-t Wood	5.3	3.9	5.6	4.3	4.7	3.8	2.7	0.0	2.6	1.2	0.0	0.0	0.6	1.3	0.0	1.3	2.4	0.8
1-u Oats	0.0	0.8	0.9	2.1	1.3	0.8	0.8	1.6	0.9	0.0	0.0	0.0	0.0	0.0	0.0	1.3	2.4	0.3

Table 1G. Showing the Percentage of answers expressed in the most common unit for the twenty Items of Section 1 of the Questionnaire. The most common unit for each item is indicated in the right-hand column.

	3rd Grade	4th Grade	5th Grade	6th Grade	Grade Total	7th Grade	8th Grade	9th Grade	Jr. H.S. To.	
1-b Gasoline	91.6	97.8	98.4	98.4	97.6	97.7	99.2	99.2	98.6	gallon
1-c Farm land	31.9	57.6	85.1	91.5	76.6	91.3	86.7	92.9	89.7	acre
1-d Milk	87.2	86.3	95.9	97.8	93.7	95.0	97.8	98.4	96.4	quart
1-e Potatoes	81.9	90.3	97.8	97.9	94.8	98.8	98.8	100.0	99.7	
1-f Dress goods	39.4	70.4	80.7	89.9	78.3	87.9	91.0	88.9	89.3	yard
1-g Meat	79.8	90.3	96.6	98.3	94.5	99.6	99.6	100.0	99.7	pound
1-h Fish	63.8	75.5	88.5	93.6	85.3	97.0	96.5	96.8	96.8	pound
1-i Apples	39.4	38.1	38.8	48.7	42.5	62.6	71.5	61.1	65.8	pound
1-j Corn	16.0	36.2	52.2	57.0	47.2	64.5	72.3	79.4	70.5	bushel
1-k Wheat	19.2	26.5	43.8	47.8	39.2	54.7	66.8	75.4	63.6	bushel
1-l Cotton lint	0.0	5.4	9.6	13.2	9.2	11.3	15.6	30.2	16.7	pound
1-m Sugar	75.5	85.6	93.8	95.7	91.1	96.6	94.0	96.8	95.4	pound
1-n Eggs	68.1	82.1	93.8	98.6	90.7	97.0	97.7	99.2	97.5	dozen
1-o Oranges	33.0	58.4	70.5	87.2	70.9	92.1	92.2	94.4	92.6	dozen
1-p Lettuce	39.3	59.1	73.3	81.6	70.2	80.5	82.4	81.7	81.5	head
1-q Bread	69.1	78.2	87.6	86.3	83.5	89.4	86.7	96.0	89.6	loaf
1-r Wool	2.1	8.6	13.0	18.0	13.0	21.1	18.4	25.4	20.9	pound
1-s Nails	13.8	30.0	39.8	45.4	37.4	52.8	53.1	61.1	54.6	pound
1-t Wood	0.0	3.1	11.5	22.9	13.0	34.3	48.0	71.4	47.0	cord
1-u Oats	10.6	14.0	26.4	29.3	23.3	38.9	48.8	69.1	47.8	bushel

(This table is completed on the following page.)

(Item number to be completed by the following table.)

Grade	Total	1st grade	2nd grade	3rd grade	4th grade	5th grade	6th grade	7th grade	8th grade
Total									
White									
Negro									
Indian									
Chinese									
Japanese									
Other races									

Used only for the twenty items of section 1 of the Questionnaire.

The most common unit for each item is indicated in the right-hand column.

Table 1G. Showing the Percentage of answers expressed in the most common unit for the twenty Items of Section 1 of the Questionnaire. The most common unit for each item is indicated in the right-hand column.

	10th Grade	11th Grade	12th Grade	Sr. H.S. Total	N. E. Adults	Mid-West Ad.	La. Adults	Cal. Adults	Adult Total	
1-b Gasoline	100.0	96.8	100.0	99.4	99.6	99.1	100.0	100.0	99.4	gallon
1-c Farm land	96.9	98.4	100.0	98.1	98.3	99.7	96.1	100.0	98.8	acre
1-d Milk	95.1	100.0	92.1	99.3	98.7	89.8	80.5	95.2	92.2	quart
1-e Potatoes	99.4	100.0	100.0	99.7	97.9	99.7	93.5	92.9	98.0	
1-f Dress goods	93.9	91.8	97.8	94.6	98.8	99.7	96.1	100.0	99.0	yard
1-g Meat	99.4	98.4	100.0	99.4	100.0	99.7	98.7	97.6	99.6	pound
1-h Fish	98.8	96.7	100.0	98.7	100.0	98.5	97.4	95.3	98.7	pound
1-i Apples	70.7	63.9	68.9	68.8	54.6	38.2	5.2	64.3	41.8	pound
1-j Corn	87.2	86.9	80.9	85.4	82.1	95.8	77.9	76.2	87.8	bushel
1-k Wheat	72.0	91.8	67.4	74.5	80.0	98.2	88.3	85.7	89.0	bushel
1-l Cotton lint	29.3	19.7	37.1	29.6	32.9	47.3	54.5	45.2	42.0	pound
1-m Sugar	96.3	98.4	96.6	97.8	97.9	95.8	94.8	83.3	95.7	pound
1-n Eggs	98.8	100.0	98.9	99.0	99.4	99.1	97.4	100.0	99.1	dozen
1-o Oranges	98.2	98.4	96.6	97.8	98.3	97.0	89.6	90.5	96.2	dozen
1-p Lettuce	87.2	91.8	92.1	89.2	93.3	48.2	79.2	85.7	69.6	head
1-q Bread	86.0	96.7	88.8	88.9	93.8	90.1	85.7	97.6	91.3	loaf
1-r Wool	40.2	21.3	50.6	39.5	45.8	88.9	74.0	71.4	68.9	pound
1-s Nails	62.8	54.1	64.0	61.4	74.8	28.3	80.5	66.7	80.9	pound
1-t Wood	57.9	78.7	60.7	62.7	72.9	82.8	67.5	71.4	76.6	cord
1-u Oats	68.9	90.2	66.2	72.4	72.9	97.6	72.7	83.3	85.4	bushel

(This table is continued from the preceding page.)

answers as shown in Table 1D, never rises to 5% with any group. In general it is heavier in Grade three and reduces gradually with the maturity of the children. There are a few exceptions under adults, particularly in the Louisiana group. The explanation of this is not obvious from the returns.

The "No answer" returns as developed on a percentage basis in Table 1E are worthy of careful study; and it is particularly interesting to compare the returns in this table with the wrong answer returns in Table 1C. Wrong answers, percentages of which are shown in Table 1C, indicate the disposition to guess. This runs up in Table 1C with third grade children to 50% in the case of Item 1-u, Oats, and is very high on a number of other items, —1-c, Farm land; 1-j, Corn; 1-k, Wheat; 1-l, Cotton lint; 1-o, Oranges; 1-r, Wool; 1-s, Nails. This statement is true only within limits. Many children who answered bale for cotton lint (Item 1-l) doubtless thought that the answer was correct. This view-point, that children thought they were answering correctly on cotton lint is supported by the fact that the percentages of wrong answers increase and become very high through the Junior and Senior High Schools. These children have seen reference to bales of cotton, but they do not know that, while cotton is handled in bales, it is always priced and sold by the pound. This same explanation would apply to some of the other items. Small children connected wool with the nursery rhyme about "three bagsful". But the percentages of wrong answers on wool likewise rises through the

Junior and Senior High School, indicating that the children doubtless thought that they were answering correctly when they gave the answer bag.

Table 1F, showing the answers that are not a unit of measure, is apparently explained by a general misunderstanding of what is wanted. In general, the percentage decreases with maturity. Reference to Exhibit 4, page 25 , showing the summary on Item 1-u, Oats, will make this clear. As shown under classification "f" at the bottom of the page, answers 9, 10, 11, 20, etc., were put under this classification. These answers are such items as balls, bar, barge, bucket, grain, meal, measure, etc. Table 1F is an attempt to completely cover all cases and show in table form whatever might be discovered. Some of the items under this head are worthy of careful study.

The purpose of Table 1G is to note for each item of Section 1 the most common retail measure used in connection with that commodity. The practice varies in different sections, but the measure was selected which was thought to be most commonly used, the country over. Some items, such as 1-b, Gasoline, are sold only by the gallon. On the other hand, an item such as 1-i, Apples, is sold in many different ways. The measure pound was taken to be the most common, but this is not the most common unit in many sections. In fruit and grocery stores the pound is probably most commonly used in selling apples. In families where apples are not very commonly used, the practice is to send for a few pounds at a time.

But in families where many apples are used, they are not usually bought by the pound, but by the bushel or box. In rural sections apples would almost never be bought or sold by the pound. This probably explains why among the children, representing the metropolitan section around Boston, the answer pound is much more common than among the Boston University students, many of whom come from other places. In rural Middle West the answer bushel reaches 72.6% of the total number of answers. For the entire group, the total number of answers under bushel is 627; under dozen, 314; under peck, 220; and under pounds, 1240. There are many multiple answers including all of these measures.

In any case, Table 1G is fully explained by giving in the right-hand column the answer that was taken as the most common measure, and which therefore affords the basis for the percentages of Table 1G. Every answer which included this measure, even when it was a part of a multiple answer, was counted in arriving at the total. For instance, the answer bushel, pound, and peck was counted among those giving the most common measure, pound, under 1-i.

Table 2A. Showing the Percentage of answers classified as "Fair estimate" to the Five Items of Section 2 of the Questionnaire.

	3rd Grade	4th Grade	5th Grade	6th Grade	Grade Total	7th Grade	8th Grade	9th Grade	Jr. H.S. Total
2-a Height of a dining-room table	3.2	3.5	10.6	11.3	8.6	10.6	9.0	9.5	9.7
2-b Width of a full-sized bed	1.1	4.7	3.7	6.9	4.9	4.5	5.1	10.3	5.9
2-c Height of a living-room ceiling	16.0	23.0	33.5	40.4	32.2	40.0	49.6	50.8	45.7
2-d Width of the side-walk in a residence section	8.5	20.2	30.1	40.9	30.1	43.4	47.3	54.0	47.0
2-e Distance between rails of a railroad	3.2	4.7	5.9	9.5	6.8	12.1	17.6	8.7	13.6

(This table is completed on the following page.)

Table 2A. Showing the Percentage of answers classified as "Fair estimate" to the Five Items of Section 2 of the Questionnaire

	10th Grade	11th Grade	12th Grade	Sr. H.S. Total	N. E. Adults	Mid-West Adults	La. Adults	Cal. Adults	Adult Total
2-a Height of a dining-room table	10.4	13.1	13.5	11.8	17.9	31.0	13.0	26.2	23.8
2-b Width of a full-sized bed	7.3	14.8	16.9	11.5	10.6	27.7	19.5	7.1	18.8
2-c Height of a living-room ceiling	51.2	45.9	55.1	51.3	47.1	68.4	37.7	47.6	55.5
2-d Width of the side-walk in a residence section	46.3	50.8	57.3	50.3	47.9	52.7	53.2	47.6	50.8
2-e Distance between rails of a railroad	15.9	8.2	13.5	13.7	23.3	32.8	26.0	14.3	27.6

(This table is continued from the preceding page.)

(Note: Table is continued from the preceding page.)

| | | |

Table 2A. This table showing the right answers for Section 2 of the test, indicates that no one, even among adults, has very great ability in estimating distance. Among children there is a tendency for the curve of frequency in this table to rise gradually with maturity. In every one of the five items, however, there is considerable inconsistency in this respect. In the case of 2-d, the width of a sidewalk, for instance, there is an increase in the number of correct answers until we get to the tenth grade. Then we see a decrease in the right answers in both the eleventh and twelfth grades. Looking at 2-a, the height of a dining-room table, we find the percentage of right answers much higher than we would expect in the fifth and sixth grades, and lower in the eighth and ninth grades.

Among the adults, the returns from the Middle West show a noticeably higher frequency of right answers than the other sections, in 2-a, the height of a dining-room table; 2-b, the width of a full-sized bed, and 2-c; the height of the ceiling of a living-room; slightly higher in 2-e, the width between the rails of a railroad; and slightly higher than all other sections except the South in 2-d, the width of a side-walk in a residence section. This better showing is probably due to the men at Indiana University, who were given the test, many of whom are from the farm, where they have had experience with estimating. Low scores here are noticeably among women and city-bred men.

The Middle Western returns were the only ones in which the men and women were separated in large enough numbers to

figure the differences. Where there was such a possibility of figuring differences, the following percentages were obtained for the two items:

		Percentage of Right Answers in Middle West	
		Men	Women
2-a.	Height of dining-room table	36.9	23.4
2-e.	Distance between the rails of a railroad	42.4	22.8

Tables 2B, 2C and 2D. Just as in the case of the tables of the preceding section, Tables 1A, 1B, 1C, 1D and 1E, so in this section, the difference between the percentage of right answers in table 2A and 100% is made up in Tables 2B, 2C and 2D. Most of this difference is divided between Tables 2B and 2D, since the totals in Table 2C, the illegible answers, is small.

It is noticeable that the smaller children do not "guess" as often in these questions as the older children, for the percentage of no answers decreases with maturity in Table 2D, and the percentage of wrong answers in Table 2B constantly increases with maturity among the children. This tendency to give an answer, no matter how little they know, persists among the adults, for here too we have as a rule a larger number of wrong answers shown in Table 2B than no answer, shown in Table 2D.

Table 2B. Showing the Percentage of Wrong Answers to the Five Items of Section 2 of the Questionnaire.

	3rd Grade	4th Grade	5th Grade	6th Grade	Grade Total	7th Grade	8th Grade	9th Grade	Jr. H. S. Total
2-a Height of a dining-room table	52.1	76.3	78.3	83.5	77.5	75.5	80.5	85.7	79.5
2-b Width of a full-sized bed	44.7	72.0	80.1	86.8	77.7	80.4	76.2	77.8	78.2
2-c Height of a living-room ceiling	26.5	48.6	47.2	49.2	46.5	37.7	36.3	42.9	38.2
2-d Width of the side-walk in a residence section	37.2	50.6	50.9	49.9	49.3	40.4	41.0	36.5	39.9
2-e Distance between rails of a railroad	37.2	65.4	65.1	79.0	71.4	74.3	66.8	83.3	73.1

(This table is completed on the following page.)

Table 68. Scores and percentages of Women Veterans to the five
items on Section 5 of the Questionnaire.

Total N. M. Score	1,267	1,267	1,267	1,267	1,267	1,267	1,267	1,267	1,267	1,267
Score N/R	1,267	1,267	1,267	1,267	1,267	1,267	1,267	1,267	1,267	1,267
Score N/O	1,267	1,267	1,267	1,267	1,267	1,267	1,267	1,267	1,267	1,267
Score N/A	1,267	1,267	1,267	1,267	1,267	1,267	1,267	1,267	1,267	1,267
Total Score	1,267	1,267	1,267	1,267	1,267	1,267	1,267	1,267	1,267	1,267
Score N/A	1,267	1,267	1,267	1,267	1,267	1,267	1,267	1,267	1,267	1,267
Score N/O	1,267	1,267	1,267	1,267	1,267	1,267	1,267	1,267	1,267	1,267
Score N/R	1,267	1,267	1,267	1,267	1,267	1,267	1,267	1,267	1,267	1,267

(Why didn't the complete or the 1,267 Veterans Data
Sheets use Section 5 of the Questionnaire.
It was to avoid duplication and confusion.)

1-a Did you receive any training in the Armed Forces which helped you in getting a job?

1-b Did you receive any training in the Armed Forces which helped you in getting a better job?

1-c Did you receive any training in the Armed Forces which helped you in getting a better job?

1-d Did you receive any training in the Armed Forces which helped you in getting a better job?

1-e Did you receive any training in the Armed Forces which helped you in getting a better job?

Table 2B. Showing the Percentage of Wrong Answers to the Five Items of Section 2 of the Questionnaire.

	10th Grade	11th Grade	12th Grade	Sr. H.S. Total	N. E. Adults	Mid-West Adults	La. Adults	Cal. Adults	Adult Total
2-a Height of a dining-room table	86.0	78.7	75.3	81.5	73.5	64.5	74.0	73.8	69.3
2-b Width of a full-sized bed	86.6	72.1	68.5	78.7	76.5	68.1	64.9	50.0	70.2
2-c Height of a living-room ceiling	39.6	36.1	29.2	36.0	41.9	26.8	48.1	26.2	35.1
2-d Width of the side-walk in a residence section	50.0	34.4	31.5	41.7	37.9	43.7	36.4	26.2	39.8
2-e Distance between rails of a railroad	77.4	77.0	71.9	75.8	54.2	57.2	51.9	47.6	55.0

(This table is continued from the preceding page.)

Table 2C. Showing the Percentage of Illegible Answers to the Five Items of Section 2 of the Questionnaire

	3rd Grade	4th Grade	5th Grade	6th Grade	Grade Total	7th Grade	8th Grade	9th Grade	Jr. H.S. Total	10th Grade	11th Grade	12th Grade	Sr. H.S. Total	N. E. Adults	Mid-West Adults	La. Adults	Cal. Adults	Adult Total
2-a Height of a dining-room table	0.0	0.8	0.0	0.0	0.2	0.0	0.4	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-b Width of a full-sized bed	0.0	1.2	0.6	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.1
2-c Height of a living-room ceiling	0.0	0.8	0.3	0.0	0.3	0.0	0.0	0.8	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-d Width of the side-walk in a residence section	1.1	0.4	0.3	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-e Distance between rails of a railroad	0.0	1.2	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2D. Showing the Percentage of "No Answers" to the Five Items of Section 1 of the Questionnaire.

	3rd Grade	4th Grade	5th Grade	6th Grade	Grade Total	7th Grade	8th Grade	9th Grade	Jr. H.S. Total
2-a Height of a dining-room table	44.7	19.5	11.2	5.2	13.7	14.0	10.2	4.8	10.7
2-b Width of a full-sized	54.3	22.2	15.5	6.4	16.9	15.1	18.7	11.9	15.9
2-c Height of a living-room ceiling	57.4	27.6	18.9	10.4	21.0	22.3	14.1	5.6	15.8
2-d Width of the side-walk in a resident section	53.2	28.8	18.6	9.2	20.3	16.2	11.7	9.5	13.1
2-e Distance between rails of a railroad	59.6	28.8	18.0	11.3	21.5	13.6	15.6	7.9	13.3

(This table is completed on the following page.)

(This table is continued on the following page.)

Table 25. Employment and payrolls in the White Sulphur Springs, W. Va., area, by selected industry, 1958 and 1954

Industry	Number of employees		Percent change	Payrolls (thousands of dollars)		Percent change
	1958	1954		1958	1954	
Total	1,700	1,600	+6.3	5,100	4,200	+21.4
Manufacturing	200	200	0.0	600	500	+20.0
Food and kindred products	100	100	0.0	300	300	0.0
Lumber and wood products	100	100	0.0	300	200	+50.0
Nonmanufacturing	1,500	1,400	+7.1	4,500	3,700	+21.6
Mining	100	100	0.0	300	300	0.0
Contract construction	100	100	0.0	300	200	+50.0
Transportation, communication, and other public utilities	100	100	0.0	300	300	0.0
Wholesale trade	100	100	0.0	300	200	+50.0
Retail trade	500	500	0.0	1,200	1,000	+20.0
Finance, insurance, and real estate	100	100	0.0	200	200	0.0
Service and miscellaneous	400	300	+33.3	800	600	+33.3
Government	200	200	0.0	600	500	+20.0

Source: Census of Business, 1958, Retail Trade, Area Statistics, and Census of Business, 1954, Retail Trade, Area Statistics.

Table 26. Employment and payrolls in the Wheeling, W. Va.-Steubenville, Ohio, area, by selected industry, 1958 and 1954

Industry	Number of employees		Percent change	Payrolls (thousands of dollars)		Percent change
	1958	1954		1958	1954	
Total	39,000	38,000	+2.6	120,000	90,000	+33.3
Manufacturing	20,000	20,000	0.0	70,000	50,000	+40.0
Food and kindred products	1,000	1,000	0.0	3,000	2,000	+50.0
Textile mill products	2,000	2,000	0.0	5,000	4,000	+25.0
Lumber and wood products	1,000	1,000	0.0	3,000	2,000	+50.0
Primary metal industries	10,000	10,000	0.0	40,000	30,000	+33.3
Fabricated metal products	2,000	2,000	0.0	6,000	4,000	+50.0
Nonmanufacturing	19,000	18,000	+5.6	50,000	40,000	+25.0
Mining	1,000	1,000	0.0	3,000	3,000	0.0
Contract construction	1,000	1,000	0.0	3,000	2,000	+50.0
Transportation, communication, and other public utilities	3,000	3,000	0.0	10,000	8,000	+25.0
Wholesale trade	1,000	1,000	0.0	3,000	2,000	+50.0
Retail trade	7,000	7,000	0.0	15,000	12,000	+25.0
Finance, insurance, and real estate	1,000	1,000	0.0	2,000	2,000	0.0
Service and miscellaneous	4,000	3,000	+33.3	8,000	6,000	+33.3
Government	1,000	1,000	0.0	6,000	5,000	+20.0

Source: Census of Business, 1958, Retail Trade, Area Statistics, and Census of Business, 1954, Retail Trade, Area Statistics.

Table 27. Employment and payrolls in the Williamson, W. Va., area, by selected industry, 1958 and 1954

Industry	Number of employees		Percent change	Payrolls (thousands of dollars)		Percent change
	1958	1954		1958	1954	
Total	3,000	3,000	0.0	8,000	6,000	+33.3
Manufacturing	100	100	0.0	300	200	+50.0
Nonmanufacturing	2,900	2,900	0.0	7,700	5,800	+32.8
Mining	1,000	1,000	0.0	3,000	2,000	+50.0
Contract construction	100	100	0.0	300	200	+50.0
Transportation, communication, and other public utilities	200	200	0.0	600	500	+20.0
Wholesale trade	100	100	0.0	300	200	+50.0
Retail trade	1,000	1,000	0.0	2,000	1,500	+33.3
Finance, insurance, and real estate	100	100	0.0	200	200	0.0
Service and miscellaneous	300	300	0.0	600	400	+50.0
Government	100	100	0.0	700	800	-12.5

Source: Census of Business, 1958, Retail Trade, Area Statistics, and Census of Business, 1954, Retail Trade, Area Statistics.

Table 2D. Showing the Percentage of "No answers" to the Five Items of Section 1 of the Questionnaire.

	10th Grade	11th Grade	12th Grade	Sr. H.S. Total	N. E. Adults	Mid-West Adults	La. Adults	Cal. Adults	Adult Total
2-a Height of a dining-room table	3.7	8.2	11.2	6.7	8.7	4.5	13.0	0.0	6.8
2-b Width of a full-sized bed	6.1	13.1	14.6	9.9	12.9	3.9	15.6	42.9	10.9
2-c Height of a living-room ceiling	9.1	18.0	15.7	12.7	11.0	4.8	14.3	26.2	9.5
2-d Width of the side-walk in a residence section	3.7	14.8	11.2	8.0	14.2	3.6	10.4	26.2	9.4
2-e Distance between rails of a railroad	6.7	14.8	14.6	10.5	22.5	9.9	22.1	38.1	17.4

(This table is continued from the preceding page.)

Table 3A. In this table we find for Item 3-a, inches in a foot, that it is familiar to a great number of the children even in the third grade. This knowledge jumps considerably in the fourth grade, where it is taught in most schools. The number of right answers increases constantly, and the scores are perfect through the Senior High School. The inch and foot are encountered constantly in practical life as well as in school.

In the case of 3-b, ounces in a pound, 3-c, inches in a yard, and 3-e, quarts in a gallon, we find considerable less knowledge in the third grade compared with 3-a, inches in a foot. In the case of all these items the number of correct answers increases noticeably in the fourth grade, where it is usually taught. Thereafter the correct answers on these three items increases steadily through the succeeding grades to the end of high school, except in the case of 3-e, where there is a drop in the 12th grade.

In the case of 3-k, cubic inches in a cubic foot, we find the expected increase in right answers with increased maturity, with a rather sudden increase in the 6th grade where it is probably taught first, this increase continuing through the Junior High School, but falling away down in the Senior High School. This item is probably affected little outside of school, being but little used.

In 3-h, the number of pennyweights in an ounce, there are very few correct answers (possibly almost entirely explainable as guesses) until we come to the ninth grade where the

Table 3A. Showing the Percentage of "Right Answers" to the eleven questions of Section 3 of the Questionnaire. Column 1 of the table shows the question and the correct answer

	Answer	3rd Grade	4th Grade	5th Grade	6th Grade	Grade Total	7th Grade	8th Grade	9th Grade	Jr. H.S. Total
3-a Inches in a foot	12	41.5	84.5	86.0	97.9	86.5	99.6	98.5	97.6	98.8
3-b Ounces in a pound	16	6.4	56.0	67.3	87.5	67.3	94.7	97.7	98.5	96.6
3-c Inches in a yard	36	11.7	72.8	76.3	89.7	75.1	93.2	96.9	97.7	95.5
3-d Acres in a ¼ section	160	0.0	0.4	0.3	1.9	0.9	2.6	1.2	8.7	3.2
3-e Quarts in a gallon	4	4.3	45.9	62.3	85.3	62.4	84.5	85.2	92.0	86.2
3-f Pounds in a bale of cotton	500	0.0	0.4	2.8	3.8	2.4	9.8	12.9	20.5	13.3
3-g Dozen eggs in a crate	30	0.0	0.8	0.6	1.2	0.8	2.6	1.2	1.6	1.9
3-h Pennyweights in an oz.	20	0.0	1.9	1.9	1.4	1.6	1.9	2.7	12.7	4.3
3-i Barleycorns in inch	3	0.0	1.9	2.5	1.9	1.9	1.1	0.8	0.0	0.8
3-j Pounds in a bu. wheat	60	0.0	0.4	0.0	0.5	0.3	5.3	2.7	10.3	5.6
3-k Cubic in. in a cu. ft.	1728	0.0	1.6	5.9	15.1	7.9	19.2	21.5	27.0	21.6

(This table is completed on the following page.)

Table 3A. Showing the Percentage of "Right Answers" to the eleven questions of Section 3 of the Questionnaire. Column 1 of the table shows the question and the correct answer.

	Answer	10th Grade	11th Grade	12th Grade	Sr. H.S. Total	N. E. Adults	Mid-West Ad.	La. Adults	Cal. Adults	Adult Total
3-a Inches in a foot	12	100.0	100.0	100.0	100.0	99.7	100.0	98.7	100.0	99.7
3-b Ounces in a pound	16	98.8	100.0	100.0	99.4	96.7	99.7	96.1	100.0	98.3
3-c Inches in a yard	36	97.6	98.4	100.0	98.4	97.1	98.2	93.5	100.0	97.4
3-d Acres in a ¼ section	160	2.4	0.0	12.4	4.8	10.3	69.3	24.7	59.5	40.2
3-e Quarts in a gallon	4	92.7	100.0	93.3	94.3	97.1	96.4	96.1	100.0	96.8
3-f Pounds in a bale of cotton	500	31.4	23.0	20.2	26.4	10.3	36.2	62.3	23.8	27.6
3-g Dozen eggs in a crate	30	3.0	1.6	10.1	4.8	13.2	26.5	1.3	11.9	17.7
3-h Pennyweights in an oz.	20	1.2	1.6	2.2	1.6	4.8	9.0	5.2	4.8	6.7
3-i Barleycorns in inch	3	2.4	3.3	1.1	2.2	1.3	1.5	3.9	0.0	1.7
3-j Pounds in a bu. wheat	60	9.7	14.8	20.2	13.7	10.3	56.0	18.2	31.0	32.2
3-k Cubic in. in a cu. ft.	1728	12.8	13.1	14.6	13.4	37.5	71.4	35.1	50.0	54.3

(This table is continued from the preceding page.)

Table 3B. Showing the Percentage of Wrong Answers to the eleven items of Section 3 of the Questionnaire.

	3rd Grade	4th Grade	5th Grade	6th Grade	Grade Total	7th Grade	8th Grade	9th Grade	Jr. H.S. Total
3-a Inches in a foot	17.1	12.2	8.4	1.9	7.5	0.4	0.0	0.8	0.5
3-b Ounces in a pound	17.1	21.4	15.6	6.9	13.7	2.3	0.8	0.8	1.4
3-c Inches in a yard	20.1	15.6	14.6	7.8	12.7	4.5	1.2	0.8	2.5
3-d Acres in a ¼ section	6.4	20.6	25.6	25.8	22.8	27.9	27.3	34.2	28.9
3-e Quarts in a gallon	7.4	35.0	24.3	11.1	20.3	10.6	13.1	6.3	10.4
3-f Pounds in a bale of cotton	19.2	43.5	46.5	49.5	44.6	52.5	43.6	54.0	49.3
3-g Dozen eggs in a crate	28.7	52.9	62.0	73.5	61.5	70.6	57.8	85.7	68.5
3-h Pennyweights in an ounce	8.5	31.1	31.8	30.5	29.1	31.7	24.6	40.5	30.6
3-i Barleycorns in an in.	11.7	28.8	26.8	24.3	25.0	27.6	22.7	42.1	28.4
3-j Pounds in a bu. wheat	14.9	33.1	36.1	33.3	32.5	36.9	23.4	38.9	32.0
3-k Cubic in. in a cu. ft	9.6	22.9	37.7	43.3	33.9	39.6	46.5	58.7	46.1

(This table is completed on the following page.)

Table 3B. Showing the Percentage of Wrong Answers to the eleven items of Section 3 of the Questionnaire.

	10th Grade	11th Grade	12th Grade	Sr. H.S. Total	N. E. Adults	Mid-West Adults	La. Adults	Cal. Adults	Adult Total
3-a Inches in a foot	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.1
3-b Ounces in a pound	0.0	0.0	0.0	0.0	2.5	0.0	1.3	0.0	1.0
3-c Inches in a yard	2.4	1.6	0.0	1.6	2.9	1.5	3.9	0.0	2.2
3-d Acres in a ¼ section	38.4	42.7	40.4	39.8	19.4	19.6	36.4	19.0	21.2
3-e Quarts in a gallon	6.1	0.0	4.5	4.5	2.5	2.7	3.9	0.0	2.6
3-f Pounds in a bale of cotton	49.9	46.0	56.2	50.6	29.4	28.9	27.3	26.2	28.8
3-g Dozen eggs in a crate	87.2	82.0	78.7	83.7	55.5	62.3	84.4	66.7	62.0
3-h Pennyweights in an ounce	37.8	23.0	32.6	33.4	14.8	29.8	31.2	19.0	23.3
3-i Barleycorns in an in.	40.2	27.9	23.6	33.1	7.5	18.4	20.8	4.8	14.0
3-j Pounds in a bu. wheat	45.8	26.2	25.8	36.3	16.4	17.5	28.6	11.9	17.8
3-k Cubic in. in a cu. ft	61.6	47.5	47.2	54.8	31.2	20.2	28.6	26.5	25.3

(This table is continued from the preceding page.)

Table 3C. Showing the Percentage of part right and part wrong answers to 3-g of the Questionnaire*.

	3rd Grade	4th Grade	5th Grade	6th Grade	Grade Total	7th Grade	8th Grade	9th Grade	Jr. H.S. Total	10th Grade	11th Grade	12th Grade	Sr. H.S. Total	N. E. Adults	Mid-West Adults	La. Adults	Cal. Adults	Adult Total
3-g Eggs in a Crate	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.2	0.0	0.0	0.0	0.0	1.6	1.5	0.0	0.0	1.3

*Drops out for all except 3-g, where alternative answers are given by 3 different people.

Table 3D. Showing Percentages of Illegible answers to the eleven Items of Section 3 of the Questionnaire.

	3rd Grade	4th Grade	5th Grade	6th Grade	Grade Total	7th Grade	8th Grade	9th Grade	Jr. H.S. To.	10th Grade	11th Grade	12th Grade	Sr. H.S. Total	N. E. Adults	Mid-West Adults	La. Adults	Cal. Adults	Adult Total
3-a Inches in a foot	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-b Ounces in a pound	0.0	0.4	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-c Inches in a yard	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-d Acres in a ¼ section	0.0	1.2	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-e Quarts in a gallon	0.0	1.2	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-f Pounds in a bale of cotton	0.0	1.5	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-g Dozen eggs in a crate	0.0	0.4	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-h Pennyweights in an ounce	0.0	0.4	0.3	0.0	0.2	0.8	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.3	1.3	0.0	0.3
3-i Barleycorns in inch	0.0	0.4	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-j Pounds in a bu. wheat	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-k Cubic in. in a cu. ft	0.0	0.4	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 3E. Showing the Percentage of "No Answers" to the eleven Items of Section 3 of the Questionnaire.

	10th Grade	11th Grade	12th Grade	Sr. H.S. Total	N. E. Adults	Mid-West Adults	La. Adults	Cal. Adults	Adult Total
3-a Inches in a foot	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.1
3-b Ounces in a pound	1.2	0.0	0.0	0.6	0.8	0.3	2.6	0.0	0.7
3-c Inches in a yard	0.0	0.0	0.0	0.0	0.0	0.3	2.6	0.0	0.4
3-d Acres in a ¼ section	59.2	57.4	47.2	55.4	70.4	11.1	39.0	21.4	38.6
3-e Quarts in a gallon	1.2	0.0	2.2	1.2	0.4	0.9	0.0	0.0	0.6
3-f Pounds in a bale of cotton	19.5	31.1	23.6	22.9	60.3	34.9	10.4	50.0	43.6
3-g Dozen eggs in a crate	9.8	16.4	11.2	11.5	29.7	9.6	14.2	21.4	18.9
3-h Pennyweights in an oz.	61.0	75.4	65.2	65.0	80.3	60.8	62.3	76.2	69.7
3-i Barleycorns in an in.	57.3	68.8	75.3	64.7	91.2	80.1	75.3	95.2	84.3
3-j Pounds in a bu. wheat	44.5	59.0	54.0	50.0	73.3	26.5	53.2	57.1	50.0
3-k Cubic in. in a cu. ft.	32.3	25.6	39.3	38.2	31.8	31.2	8.4	36.4	23.5

(This table is completed on the following page.)

TABLE 3E. Distribution of Deaths from Diseases of the Nervous System and of the Organs of Special Sense, by Sex, Age and Color, in the Registration States, 1939.

Items to be distributed are the deaths assigned to subheadings of the group in the International List of Causes of Death.

Cause of death	All ages	Under 1 year	1 year	2 years	3 years	4 years	5-9 years	10-14 years	15-19 years	20-24 years	25-29 years	30-34 years	35-39 years	40-44 years	45-49 years	50-54 years	55-59 years	60-64 years	65-69 years	70-74 years	75-79 years	80-84 years	85 years and over	Unknown
Total, all causes																								
White																								
Colored																								
Diseases of the nervous system																								
White																								
Colored																								
Meningitis, tuberculous																								
White																								
Colored																								
Meningitis, epidemic																								
White																								
Colored																								
Meningitis, other forms																								
White																								
Colored																								
Meningitis, unspecified																								
White																								
Colored																								
Encephalitis, epidemic																								
White																								
Colored																								
Encephalitis, other forms																								
White																								
Colored																								
Encephalitis, unspecified																								
White																								
Colored																								
Poliomyelitis, acute anterior																								
White																								
Colored																								
Poliomyelitis, unspecified																								
White																								
Colored																								
Tetanus																								
White																								
Colored																								
Tetanus neonatorum																								
White																								
Colored																								
Tetanus, other forms																								
White																								
Colored																								
Tetanus, unspecified																								
White																								
Colored																								
Chorea																								
White																								
Colored																								
Chorea, Huntington's																								
White																								
Colored																								
Chorea, other forms																								
White																								
Colored																								
Chorea, unspecified																								
White																								
Colored																								
Epilepsy																								
White																								
Colored																								
Epilepsy, idiopathic																								
White																								
Colored																								
Epilepsy, other forms																								
White																								
Colored																								
Epilepsy, unspecified																								
White																								
Colored																								
Hydrocephalus																								
White																								
Colored																								
Hydrocephalus, congenital																								
White																								
Colored																								
Hydrocephalus, other forms																								
White																								
Colored																								
Hydrocephalus, unspecified																								
White																								
Colored																								
Cerebral hemorrhage																								
White																								
Colored																								
Cerebral hemorrhage, congenital																								
White																								
Colored																								
Cerebral hemorrhage, other forms																								
White																								
Colored																								
Cerebral hemorrhage, unspecified																								
White																								
Colored																								
Cerebral embolism																								
White																								
Colored																								
Cerebral thrombosis																								
White																								
Colored																								
Cerebral softening																								
White																								
Colored																								
Cerebral apoplexy, unspecified																								
White																								
Colored																								
Cerebral apoplexy, other forms																								
White																								
Colored																								
Cerebral apoplexy, unspecified																								
White																								
Colored																								
Paralysis																								
White																								
Colored																								
Paralysis agitans																								
White																								
Colored																								
Hemiplegia																								
White																								
Colored																								
Paralysis, other forms																								
White																								
Colored																								
Paralysis, unspecified																								
White																								
Colored																								
Other diseases of the nervous system																								
White																								
Colored																								
Other diseases of the nervous system, congenital																								
White																								
Colored																								
Other diseases of the nervous system, other forms																								
White																								
Colored																								
Other diseases of the nervous system, unspecified																								
White																								
Colored																								
Diseases of the organs of special sense																								
White																								
Colored																								
Diseases of the eye																								
White																								
Colored																								
Blindness																								
White																								
Colored																								
Blindness, both eyes																								
White																								
Colored																								
Blindness, one eye																								
White																								
Colored																								
Blindness, unspecified																								
White																								
Colored																								
Other diseases of the eye																								
White																								
Colored																								
Other diseases of the eye, congenital																								
White																								
Colored																								
Other diseases of the eye, other forms																								
White																								
Colored																								
Other diseases of the eye, unspecified																								
White																								
Colored																								
Diseases of the ear																								
White																								
Colored																								
Deafness																								
White																								
Colored																								
Deafness, both ears																								
White																								
Colored																								
Deafness, one ear																								
White																								
Colored																								
Deafness, unspecified																								
White																								
Colored																								
Other diseases of the ear																								
White																								
Colored																								
Other diseases of the ear, congenital																								
White																								
Colored																								
Other diseases of the ear, other forms																								
White																								
Colored																								
Other diseases of the ear, unspecified																								
White																								
Colored																								

Table 3E. Showing the Percentage of "No Answers" to the eleven Items of Section 3 of the Questionnaire.

	3rd Grade	4th Grade	5th Grade	6th Grade	Grade Total	7th Grade	8th Grade	9th Grade	Jr. H.S. Total
3-a Inches in a foot	41.5	3.5	5.6	0.2	6.1	0.0	1.6	1.6	0.8
3-b Ounces in a pound	76.6	22.2	17.1	5.7	19.0	3.0	1.6	0.8	2.0
3-c Inches in a yard	68.1	11.7	9.0	2.6	12.2	2.2	2.0	1.6	2.0
3-d Acres in a ¼ section	93.6	77.8	74.1	72.4	76.0	69.4	71.5	57.2	67.9
3-e Quarts in a gallon	88.3	17.9	13.4	3.5	17.1	4.9	2.7	1.6	3.4
3-f Pounds in a bale of cotton	80.8	54.0	51.3	47.0	52.7	37.6	43.3	25.5	37.4
3-g Dozen eggs in a crate	71.2	45.5	37.4	25.3	37.5	26.8	40.6	12.7	29.5
3-h Pennyweights in an oz.	91.5	66.5	66.0	68.1	69.1	65.6	72.7	46.8	64.8
3-i Barleycorns in an.	88.3	68.9	70.7	73.7	73.0	71.3	76.6	57.9	70.8
3-j Pounds in a bu. wheat	85.1	66.5	63.9	66.2	67.2	57.1	73.9	50.8	62.4
3-k Cubic in. in a cu. ft.	90.4	75.1	56.4	41.4	58.0	41.2	32.0	14.3	32.3

(This table is continued from the preceding page.)

(Data table is continued from the preceding page.)

percentage of correct answers is 10.7. In the Senior High School again the correct answers drop to 1.2%, 1.6% and 2.2% in the tenth, eleventh, and twelfth grades, respectively. Not even in the adult groups, where there are many teachers, do we ever see the percentage of correct answers as high as it is in the ninth grade. Evidently it was taught there some, and immediately forgotten. This item has no practical application in the lives of almost all of these people.

There is the usual gradual increase in the knowledge of 3-f, the number of pounds in a bale of cotton. This is true until we come to the eleventh grade where we see a drop, followed by a further drop in the twelfth grade.

There is very little knowledge evidenced among children of the number of dozen eggs in a crate. There are probably a few throughout the grades whose fathers are in the chicken business and who pack eggs; this would account for the few correct answers. There is a decidedly higher score in the twelfth grade than in any of the others—10.1% correct. The next best score was in the tenth grade—3.0% correct.

The number of correct answers among adults is very high on Items 3-a, the inches in a foot, 3-b, the ounces in a pound, 3-c, the inches in a yard, and 3-e, the quarts in a gallon. These are commonly used measures in every-day life the country over.

Aside from these four items, however, the adults do not reach high scores, except in a few cases.

Under 3-d, the acres in a quarter-section, only the Middle Western and California groups reach high scores, these being respectively, 69.3% and 59.5% correct. In New England farm land is not ordinarily thought of in sections or quarter-sections as it is in the Middle West. The Middle West shows up well also under 3-k, the cubic inches in a cubic foot. This is not so easily explained.

The Louisiana group attained an exceptionally high score (62.3% correct) on Item 3-f, the pounds in a bale of cotton, as compared with the average of right answers for adults, 27.6%. Cotton is king in New Orleans.

The Middle West shows up well also in Items 3-g, dozen eggs in a crate, and 3-j, the pounds in a bushel of wheat. Both of these items have been at some time a part of the every-day life of most Middle Westerners.

On Items 3-h, the pennyweights in an ounce, and 3-i, the barleycorns in an inch, no group among the adults gets a good score. Why should they? These measures are outside of their experience. Many learned the number of pennyweights in an ounce; no one learned the number of barleycorns in an inch. Both are properly encyplopaediac knowledge.

Tables 3B, 3C, 3D and 3E. As explained on page 54, in connection with Tables 1B, 1C, 1D and 1E, so Tables 3B, 3C, 3D and 3E make up the difference between Table 3A and 100%. Practically the same comments which apply to those four tables are applicable to Tables 3B, 3D, 3C and 3E.

There are so many items included in the test, that no attempt has been made to explain or even to comment on every item. What has been attempted is to show the plan of the study, to show data fully enough to permit the reader to study them and to reach his own conclusions, and to get from the data some of the more obvious meanings. The next two chapters are devoted to the significance of differences in the percentages shown and to the evident conclusions.

V. Significance of the Percentage Differences.

Chief reliance for conclusions in this study is placed upon the tables of percentage of various types of responses as shown in Tables 1A, 1B, 1C, 1D, 1E, 1F, and 1G, covering Section 1 of the questionnaire; Tables 2A, 2B, 2C, and 2D, covering Section 2 of the questionnaire; and Tables 3A, 3B, 3C, 3D and 3E, covering Section 3 of the questionnaire.

The discussion of these tables has called attention to differences and their probable explanation. At an early stage in the study, steps were taken to ascertain statistically the significance of these differences. It is the purpose of this brief section to explain the method or formula for determining the significance of these differences; to apply the formula to a typical case; and to try to give a general idea of the differences that are statistically significant.

Holzinger gives an equation for the probable error of a percentage frequency, being Equation 102, page 243, of his Statistical Methods for Students of Education (4), as follows:

$$P.E._{f_p} = .6745\sqrt{\frac{f_p(100-f_p)}{N}}$$

in which f_p is the percentage score or frequency, and N is the number of cases.

Applying this formula to Table 1A, column 13, New England adults, and Item 1-k, wheat, we have

---

The writer wishes to acknowledge the careful direction of her faculty advisor, in the preparation of this chapter.

$$\text{P. E. of } 79.0 = .6745\sqrt{\frac{79.0\ (100-79.0)}{310}} = 1.56$$

This particular 79.0 may be thought of therefore as 79.0 ± 1.56. The value of N, the number of New England adults, is taken from the data on the number of cases, given on page 18.

There the matter might rest, except for the fact that the present purpose is to note differences. If 79.0% of the New England adults answer correctly, and 94.3% of Middle West adults answer correctly, the difference is 15.3% in favor of the Middle West adults. How significant is this percentage difference of 15.3?

Holzinger, in the reference given, page 244, develops the formula for the significance of percentage differences, as follows:

$$\text{P.E. (diff)} = \sqrt{(\text{P.E.of 1st percent})^2 + (\text{P.E. of 2d percent})^2}$$

Now applying the Holzinger formula 102 to the 94.3% for Middle West adults, we secure for the P.E._{f_p}:

$$\text{P.E. of } 94.3\% = .6745\sqrt{\frac{94.3\ (100-94.3)}{332}} = .8566$$

This particular 94.3 may be thought of therefore as $94.3 \pm .86$.

Applying now the Holzinger formula 102a as given above, in order to secure the probable error of the difference of these two percents, 79.0 and 94.3, we have:

$$\text{P.E. (diff.)} = \sqrt{(1.56)^2 + (.86)^2} = 1.78$$

Therefore the difference 94.3 - 79.0 may be written

$$15.3 \pm 1.78$$

This difference being more than five times the P.E. is a significant difference.

By applying this same procedure, percentage differ-

P. E. of 79.0 = .6745 $\sqrt{\frac{79.0\,(100-79.0)}{100}}$ = 1.38

This particular 79.0 may be thought of therefore as 79.0±1.38. The value of 1, the number of New England adults, is taken from the data on the number of cases, given on page 15.

There the matter might rest, except for the fact that the present purpose is to note difference. If 79.0% of the New England adults answer correctly, and 94.2% of Middle West adults answer correctly, the difference is 15.2% in favor of the Middle West adults. How significant is this percentage difference of 15.2?

Holzinger, in the reference given, page 244, develops the formula for the significance of percentage differences, as follows:

P.E. (diff) = $\sqrt{(\text{P.E. of 1st percent})^2 + (\text{P.E. of 2d percent})^2}$

Now applying the Holzinger Formula 102a to the 94.2% for Middle West adults, we secure for the P.E.:

P.E. of 94.2% = .6745 $\sqrt{\frac{94.2\,(100-94.2)}{100}}$ = .6888

This particular 94.2 may be thought of therefore as 94.2±.69.

Applying now the Holzinger Formula 102a as given above, in order to secure the probable error of the difference of these two percents, 79.0 and 94.2, we have:

P.E. (diff.) = $\sqrt{(1.38)^2 + (.69)^2}$ = 1.54

Therefore the difference 94.2 - 79.0 may be written

15.2 - 1.54

This difference being more than five times the P.E. is a significant difference.

By applying this same procedure, percentage differ-

ences in any of the tables:

1A, 1B, 1C, 1D, 1E, 1F, and 1G;

2A, 2B, 2C, 2D:

3A, 3B, 3C, 3D, and 3E

may be figured as to their statistical significance.

Mere inspection of Tables 1A, 2A, 3A, etc., makes it evident that there are many significant differences; several of these have been discussed in detail. It is, e. g., obviously significant:

that only 77.1% of Middle West adults give correct answers on the unit sale of milk, as against 94.6% for the Boston area, designated as New England, (see Item 1-d, Table 1A);

that only 37.3% of Middle West adults give correct answers on the unit of retail sale of lettuce, as against 90.0% for the Boston area (see Item 1-p, Table 1A);

that only 4.3% of third grade children give correct answers to the number of quarts in a gallon, as against 45.9% in fourth grade, 62.3 in the fifth grade, and 85.3% in the sixth grade (see Item 3-e of Table 3A). Here each difference is significant; evidently growth and experience, supported by teaching in the schools, are making a rapid change.

There are evidently many significant percentage differences.

On the other hand, some of the differences that are not significant as differences, become significant because of agreement. For example, the percentage difference of right answers on

may be figured as to their statistical significance.

the unit for the sale of gasoline (Table 1A, Item 1-b) is very small at all grades and in all sections. This means that the knowledge of the unit of sale of gasoline is acquired early in life and that such knowledge is almost perfect for all groups above the third grade included in the study. This in turn means that the experience is widely distributed. And this means that in this case at least experience does the work of teaching without any help from the schools.

The knowledge of how eggs are sold shows early and rapid approach to perfect knowledge, although at every age it lags a little behind gasoline in percentage of correct answers. The slope of this curve suggests maturation as the chief factor.

In like manner the unit for the sale of bread is generally known after grade five, and dress goods after grade six. There is a significant difference, however, between correct answers on dress goods in grade three and grade four. Evidently children of grade three do not have the experience with dress goods or do not notice or comprehend it.

It would be interesting to know the results of applying the percentage difference formulae to all of the comparable differences in all the items in Tables 1A, 1B, 1C, 1D, 1E, 1F and 1G; 2A, 2B, 2C, and 2D; 3A, 3B, 3C, 3D and 3E. But this amount of labor seems hardly called for in a master's thesis. Over 20,000 differences could be figured.

The Holzinger formula is appropriate for determining percentage differences since it involves the percentage figure as is, i. e., with zero as a base, thus showing variation for

increase or decrease in percentage.*

---

*The Edgerton-Patterson tables (3) serve the same purpose.

VI. Summary and Conclusions

The present study would be less conclusive if a first study and standing alone. But it does not stand alone. It follows and supports and is supported in turn by the studies of Louth, Sala and Traniello, as well as earlier studies of usage. Thus it becomes a study in a series of similar studies which indicate the uselessness of much that is taught in denominate numbers.

The earlier studies of usage (Numbers 1 to 11, pages 3 to 11) called attention to the fact that many things were being taught in denominate numbers which were clearly non-functional in the lives of children and adults. A questionnaire study by a group of summer students at Boston University (unpublished), covering ninety-two of the larger industries of the country, showed little use for the type of denominate numbers taught in the schools, namely: tables, reductions, and the processes of addition, subtraction, multiplication and division of compound numbers. The intensive study of fifteen industries by Louth, Sala and Traniello gave further evidence that the schools in their usual work in denominate numbers and measures were simply carrying a traditional load of little or no value at the time and having little or no later value in industry for adults.

The present study was planned as a first study along a slightly different line, namely: to check upon the knowledge of measures possessed by children at different age levels and by adults (in this particular case, college students) in different parts of the country. The findings of this study are not in conflict with other studies, but rather

in complete agreement in so far as the limits of the study permit conclusions. Among the conclusions that seem justified are the following:

1. Elementary school children, even as far down as the third grade, do have a knowledge of the measures which are used in buying commodities commonly used in the family, such as bread, milk, eggs, sugar, and gasoline.

2. During the years when children are ordinarily studying denominate numbers and measures in the schools there is in general an increase in the knowledge of measure and measuring practices. This is not uniform for different facts, and apparently the explanations for lack of uniformity are various. All told, experience seems to be the most important factor. If a fact or practice, such as the buying of gasoline, is so common as to come within the experience of all children at an early age, then that fact is known regardless of any teaching done by the schools. On the other hand, children may deal with such items as the selling of wheat or wool in written problems in text-books without learning much about it.

The summary data shown in the Tables 2A, 2B, 2C, and 2D appear to indicate that, although measures may be taught in the schools, the significance of the measures from the standpoint of application is little known. It is surprising to find how inaccurate are the estimates of the height of a dining-room table and what exaggerated estimates are made. Apparently much of the teaching in the schools is memorization without meaning. Practical understanding and usage are neglected objectives.

The Tables 3A, 3B, 3C, 3D, and 3E, emphasize another point, namely: that tabled facts, unless they come within the experience of the children, are little known. Most children, at an early age, know the number of inches in a foot. Knowledge of the number of inches in a yard comes a little more slowly and lags throughout, even with adults, while the number of cubic inches in a cubic foot, another tabled fact generally taught in the schools, is little known by any group, and the number of correct answers barely exceeds fifty percent in the adult group.

Other items, such as the number of pennyweight in an ounce, or the number of dozens of eggs in a crate, the former generally taught and the latter almost never, keep on about the same low level of correctness in responses.

3. Table 3A seems to indicate that some measures are better known in the ninth grade than either earlier or later. It is possible that the teaching of such an item as the number of cubic inches in a cubic foot does begin to make a difference at about the sixth grade and increases somewhat through grades seven, eight and nine and then falls in grades ten, eleven and twelve. Adults, on the other hand, at the college level, have a knowledge much above the ninth grade group on this particular item. The high score of the ninth grade group on the number of pennyweight in an ounce seems to require some special explanation. It is possible that some of the tested groups had encountered this fact very recently and therefore had a knowledge at hand for the test. On the other hand, it may be that the teaching of these facts in the schools makes a slight difference and so raises the score at the time of such teaching. Lack of usage causes such knowledge to disappear rapidly.

4. Adults know very well the measures used in buying and selling commodities with which they have had experience; they know little about the measures used in buying and selling commodities with which they have not had experience. Adults know very well the tabled facts which they commonly use. They do not know those which they do not use, even when they were studied in school. In general they are not able to estimate heights, lengths and distances with any credible degree of accuracy.

5. The sectional variation in knowledge of denominate numbers and measures argues that experience rather than training in school is the most important factor in determining one's knowledge of measures. Schooling is reasonably uniform the country over. If schooling were the determining factor we should expect much agreement. The reverse is true. And when any detail showing marked variation is checked, the differences are found to be explained by difference in experience.

Furthermore, experience is the factor that makes permanent a knowledge of the measures that are taught in the schools. If facts and measures are not used they tend to disappear.

6. One cannot escape the conclusion that maturation and experience are the chief factors accounting for knowledge of measures. It would appear that the facts of denominate numbers and measures are in the nature of encyplopediac information to be looked up when needed and not taught with the expectation that, if memorized, the facts will be remembered.

VII. Further Suggested Studies

The present study has purposely spread widely in order to test out large numbers of items. Taking the present findings as a start, it should be possible to carry forward a number of intensive studies that will show with greater certainty why the pupils and adults have or have not a knowledge of specific measures.

1. Significant differences can be studied through the use of commodities generally known in one section and not known in other sections. The study on a sectional basis should extend to pupils in the schools. In this study it is confined to students in normal schools and universities.

2. Differences due to sex are not included in the present study. A small study was made and carried far enough to indicate that sex differences are apparently significant with some measures. A study designed to emphasize sex differences might further indicate that experience is the chief item in knowledge of denominate numbers and measures.

3. It would be interesting to have carried forward a control experiment in a large school system in which one group was taught the usual text-book tabled facts and processes and in which the experimental group was taught none of these things, but led to develop and intensify experience. The comparison after three or four years of this type of teaching should be profitable.

4. The present study has some easily recognized limitations. The children are from one section of the country. The adults are all students in normal schools, colleges or universities, and therefore a highly specialized group. A procedure similar to the pupil-school survey method* is needed that will reach a thoroughly representative group of adults in communities studied.

5. The use of Form 2 of the basic test (See Exhibit 2, page 21) in a further study would help in eliminating errors of interpretation. There would be a more specific check on schooling as against experience as the reason for knowing certain facts or measures.

6. This study in simplified form could be used with great profit by committees working upon the course of study in arithmetic for any community. What are the experience opportunities in measures provided by the local community? What has been the effect of teaching text-book facts and procedures?

---

* See Chapter 1 of "What Arithmetic Shall We Teach", by G. M. Wilson Houghton Mifflin, 1926

VIII. Bibliography

1. Charters, W. W.: Curriculum Construction. Macmillan, 1923
2. Dalrymple, Charles Orson: The Fractions of Business and Life. Boston University, School of Education. Doctor's dissertation, 1932
3. Edgerton, H. A. and Patterson, D. G.: Table of Standard Errors of Percentage for Varying Numbers of Cases. Journal of Applied Psychology 10:378-391. 1926
4. Holzinger, Karl J.: Statistical Methods for Students in Education. Ginn & Co. 1928
5. Jessup, W. A.: Economy of Time in Arithmetic. Elementary School Teacher, Volume XIV, No. 10. June, 1914
6. Louth, Mary De Sales: Units of Measurement in Industry. Graduate School, Boston University . Master's thesis, 1931
7. Monroe, W. S.: Part I, Sixteenth Yearbook, National Society for the Study of Education
8. Sala, Vincent: Denominate Numbers Used in the Factories of New Britain, Conn. School of Education, Boston University, Master's thesis, 1934
9. Traniello, Angelo: The Use of Talbes of Measurement in Business. School of Education, Boston University. Master's Thesis, 1930
10. Williams, I. W.: The Mathematics Needed in Freshman Chemistry, School Science and Mathematics, Vol. XXI, No. 7, October, 1921

11. Wilson, G. M.: Course of Study in Mathematics, Connersville, Ind., 1911. Reprinted by Warwick & York, Baltimore, 1922

12. Wilson, G. M.: What Arithmetic Shall We Teach? Chapter II. Houghton Mifflin Co. 1926

13. Wise, Carl T.: Arithmetic Problems Arising in Various Occupations. Elementary School Journal, Oct., 1919

14. Woody, Clifford: Types of Arithmetic Needed in Certain Types of Salesmanship. Elementary School Journal, Vol.22. March, 1922

Appendix

This appendix gives for each item of Section I of the questionnaire a complete list of the answers given and classifies these answers as right or wrong; it also gives the most common unit of measure for these items.

It lists the answers which are considered a fair estimate for the items of Section 2.

The correct answers for the items of Section 3 are given in Table 3A, page 71.

Section 1.

1-b, Gasoline. See Exhibit 3.

1-c, Farmland.

Right: acre, arpent, farm, piece, section

Wrong: ac, acea, acears, aces, acra, acrea, feet, mile, lot, rod, arc, arca, arces, area, ares, bushel, crate, ecark, eges, feet, field, garden, ground, horse, houseland, inch, land, length, lettuce, level, many, measure, mile, milk, money, numbers, ounce, packages, peck, pint, pounds, property, quarts, retail, rod, sale, seed, sold, square, sq. ft., sq. mi., sq. rd., tomatoes, ton, vegetables, yard, 5 acres, 5 inch, 12 erges, 20 aces, 100's

Most common unit: acre

1-d, Milk

Right: bottle, quart, liter, pint, quart bottle, quart can, $\frac{1}{2}$ pint

Wrong: bushel, can, cows, gallon, pound, gasoline, gill, hundred pounds, liquid measure, ounce, qur, retail, test to the pound, ton, weight, 10¢

Most Common unit: quart

1-e, Potatoes

Right: bag, peck, pound, bushel, hundredweight, half-bushel, hamper, sack

Wrong: barrel, quart, buise, dozen, dry measure, gallon, garden, package, pint, quart, retail, ton, weight, 12¢

Most common measure: pound, bushel, peck

1-f, Dress goods

Right: yard, inch

Wrong: a dress, age, article, bale, box, bushel, by word, can, carco, cargo, cent, clotch, cloth, clothes, dollars, dozen, gross, dress, each, feet, general, gingham, groce, hosery, length, linea measure, lots, material, mayonnaise, measure, money, numbers, one, one or two, ounce, package, pair, packs, pattern, peck, piece, pound, quality, quart, racks, shop, singular, size, square yards, store, suits, ton, width, wool, years, 15", 50¢.

Most common unit: yard

1-g, See Exhibit 4.

1-h, Fish

Right: can, pound, each, quart, per fish

Wrong: barrel, bushel, catch, cords, dozen, foot, gills, half-pound, head, inch, lt, ounce, paper, retail, sea, size, slice, ton, water, weight, width, whole, 1, 5¢, half.

Most common unit: pound

1-i, Apples

Right: barrel, bushel, peck, pound, quart, basket, box, dozen, each, crate, half-dozen

Wrong: bag, dry measure, general, money, red, tall, weight, 3 for 10¢, 25¢.

Most common unit: bushel

1-j, Corn

Right: bushel, can, dozen, ear, hundred pounds, half-dozen, 12 ears, hundred weight.

Wrong: acre, bale, barley, barrel, basket, box, bunch, car, carton, cob, cod, core, each, pound, eyes, fresh corn, foot, garden, general, grain, heads, husk, inch, kernel, leaves, (meal) pound, measure, number, pack, package, peck, pound, piece, quart, sack, seed, stacks, stalks, stock, ton, unit, weight, ounce, 5 ears, 20, 30¢, 60, 100 bushel.

Most common unit: bushel

1-k, Wheat

Right: bushel

Wrong: acre, bag, pound, weight, bale, ball, barrel, bin, box, bread, bucket, bunch, bundles, hundred weight, package, peck, sack, ton, bushes, can, dozen, ear, farmer, field, flour, flour (pound), foot, gallon, grain, gross, hundred pounds, inch, load, measure, mile, ounce, pack, pint, quart, retail, sheafs, stack, stalk, stock, wheat, yard, stick, 1 lb. box, 10¢, 70.

Most common unit: bushel

1-l, Cotton lint

Right: pound

Wrong: acre, bag, bale, ball, barrel, bolt, bottle, box, bulk, bunch, bushel, can, carton, dozen, dress, dry goods, foot, gallon, 5 gallons, general, goods, dry goods, humdredweight, inch,

3 inch, jar, material, ounce, pack, package, pail, peck, pieces, pint, quaft, roll, sack, size, spool, square foot, store, ton, string, weight, yard, spool, 12, 5¢, each.

Most Common unit: pound

1-m, Sugar

Right: bag, box, pound, carton, hundred pound, hundredweight, package, sack, 2 pounds, 5 pounds, 10 pounds, 25 pounds.

Wrong: bale, barrel, bushel, butter, ounce, peck, ton, weight, 5¢, 10, retail.

Most common unit: pound

1-n, eggs

Right: case, dozen, crate

Wrong: box, bushel, eggs, half-dozen, hen, number, ounce, oranges, pound, retail, year, 20 eggs, 25¢.

Most common unit: dozen

1-o, Oranges

Right: bag, dozen, box, case, crate, peck, each, gross, half-dozen, package of 100.

Wrong: bunch, bushel, by number, oranges, ounce, pound, quantity, quart, retail, tree, 3 for 10¢, 25¢.

Most common unit: dozen

1-p, Lettuce

Right: bunch, head, each

Wrong: amount, pound, bushel, bag, ball, box, bushel, bread, crate, loose, dozen, foot, garden, green, hamper, head in pound, ounce, package, peck, piece, retail, size, roll, singular, size, little, 8¢ each, 5 for 10¢ or ?, 15¢.

Most common unit: head

1-q, Bread

Right, each; loaf; loaf, number of ounces; loaf, one pound; loaf, 1 pound, 4 ounces; loaf, 1 or 1/2 pound; loaf (ounces); pound loaf.

Wrong, general, gross, half-pound, head, load, number, number of units, one, ounce, pound, package, paper, peck, piece; pound, fraction of; pound, fraction of loaf; singer, singular, size, slice, soft, sold, tin, weight, white, 1 or 2 bread, 2 loaves, 8¢ each, 10, 24 pounds, 16 ounces equals 1 pound.

Most common unit: loaf

1-r, Wool

Right: pound

Wrong: acre, bag, bale, hundredweight, weight, bushel, yard, ball, skein, barrel, basket, bat, bl., blushes, bobbin, box, bulk, bunch, bundle, carload, carton, cloth, clothes, dresses, cloth in yard, cord, crate, dozen, feet, inches, fleece, general, gin, grate, gross, hank, in cloth, in clothes, keg, material, ounce, package, peck, piece, sack, shank, ton, raw, roll, sheaf, sheep, size, weight, weight for money, 3 yards, 20¢

Most common unit: pound

1-s, Nails

Right: keg, pound

Wrong: bag, barrel, box, dozen, barrow, basket, bl., bll., board feet, bulk, can, bucket, bunch, bushel, cake, gross, carton, cent's worth, cord, core, crate, handful, head,

hogshead, hundred, inch, jar, ounce, so many for 5¢, kinds, length, man, number, pack, package, peck, peg, penny, penny-weight, pint, polish, quart, ton, weight, size, small, barrel, tall, ten or any amount, thousands, tin, wood, 5¢, 10¢.

Most common unit: pound

1-t, Wood

Right: bushel, cord, load, rack, rick, truck-load wagon-load

Wrong: acre, bag, basket, ton. bale, barrel, carload, bin, block, board feet, square foot, running foot, boards, box, bunch, bundle, peck, rod, ton, foot, carful, cartings, cubic foot, lot, pound, rank, thousand, tier, yard, core, count, crate, cube, cubic measure, cut load, dozen, factory, inch, gallon, general, gross, kinderlin, knot, length, width, linear foot, lineal foot, logs, lumber, mears, measurements, number, number of feet and quality, ounce, package, peck, piece, pile, pint, plank, puck, rail, rod, sack, size, sticks, store, strict, tree, timberweight, tumber, wood bin, 1/2 bushel, 2 x 4, 6 inches, 6 pieces, 20¢, 1000 feet.

Most common unit: cord

1-u, Oats,

See Exhibit 4, Page 25.

Section 2

2-a, The height of a dining-room table.

Fair estimate*: 28 inches to 34 inches, inclusive

2-b, Width of a full-sized bed.

Fair estimate: 50 inches to 58 inches, inclusive

2-c, Height of the ceiling of a living-room.

Fair estimate: 7feet to 10 feet, inclusive

2-d, Width of a sidewalk in residence section

Fair estimate: 4 feet to 6 feet, inclusive

2-e, Width between rails of a railroad track

Fair estimate: 4 feet,1 inch to 5 feet, inclusive

Section 3. See table 3A. page 71, for right answers.

---

*Everything within these limits was considered correct whether expressed in feet, inches, yards or a combination of any of them.

BOSTON UNIVERSITY
1 1719 02548 3332